PROJECT PIPELINE

Barracks Road (Route 654)

CITY OF CHARLOTTESVILLE/ALBEMARLE COUNTY

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

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1. Chapter 1 – Needs Evaluation and Diagnosis

1.1 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 1-1**.

Figure 1-1. Project Pipeline Objectives

1.2 Background

The Office of Intermodal Planning and Investment (OIPI) prepared 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 1-1**. This study focuses on addressing needs identified in VTrans, and those previously identified by the localities.

Table 1-1. List of VTrans Needs

VTrans Needs
Bicycle Access
Safety Improvement
Transit Access
Capacity Preservation
Pedestrian Access
Transportation Demand Management
Transit Access for Equity Emphasis Areas

1.3 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 1-2.**

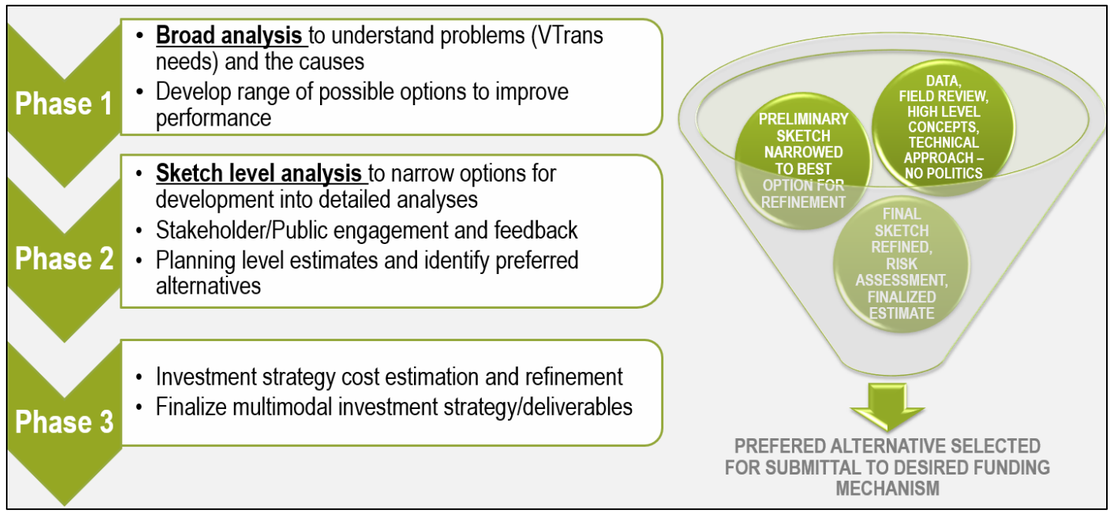


Figure 1-2. Study Phase Methods and Solutions

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 1-3.**

Figure 1-3. 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 1-2**.

Table 1-2. 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					

1.4 Study Area

The Barracks Road (Route 654) study corridor from Georgetown Road (Route 656) to Emmet Street N (US 29 Business) is in the City of Charlottesville and Albemarle County, Virginia. Barracks Road is classified as a Minor Arterial within the study area. The posted speed limit is 35 MPH. There are six median crossovers within this 0.79-mile corridor along Barracks Road. A map detailing the locations of the study intersections along Barracks Road is shown below in **Figure 1-4**.

Figure 1-4. Barracks Road (Route 654) 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 that correspond 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 Barracks Road study corridor, were identified as 'Very High' for Bicycle Access, Safety Improvement, Transit Access, and 'High' for Transportation Demand Management, Capacity Preservation, and Pedestrian Access needs.

[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

1.5 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 full STEAP Tool report is provided in **Appendix A**. The results of the STEAP Tool analysis are presented below:

- Of the non-English speakers (age 5+) at home, everyone speaks English very well, as shown in **Figure 1-5.**
- The majority of the population (73%) within the study area is between ages 18 and 64, as shown in **Figure 1-6.**
- There is a high personal vehicle ownership, with 39% of households owning one vehicle and 35% owning two. Only 11% of households do not own a personal vehicle, as shown in **Figure 1-7.**
- Compared to the State of Virginia, the study area has fewer veterans, people with disabilities, households with no computers, and households without internet connection, as shown in **Figure 1-8**. The study area in these categories has demographics identical to the City of Charlottesville.
- Of all the households in the study area, 43% have household income greater than $75,000, as shown in **Figure 1-9**. This is the same percentage as the City of Charlottesville.

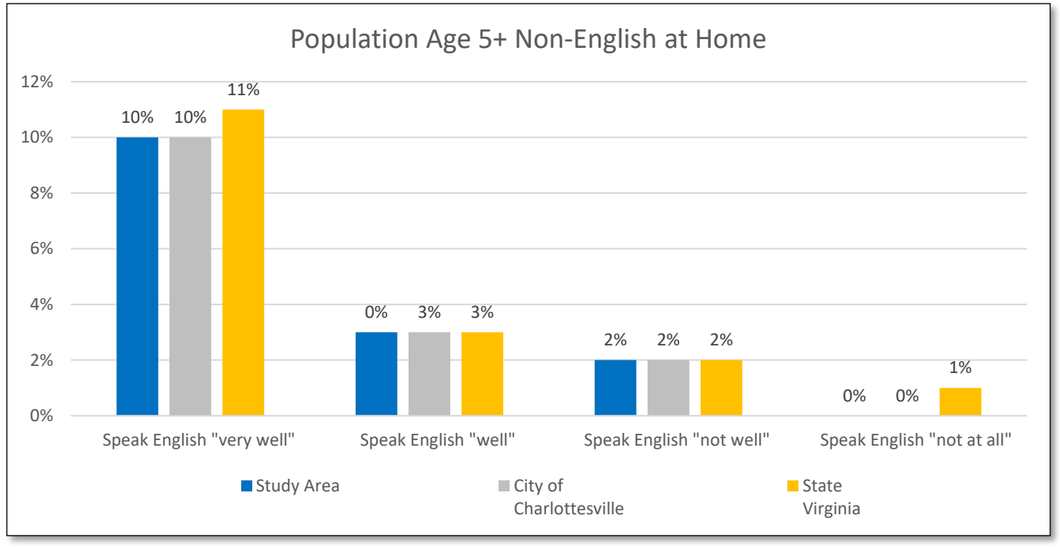


Figure 1-5. STEAP Tool Analysis Population by Age Group

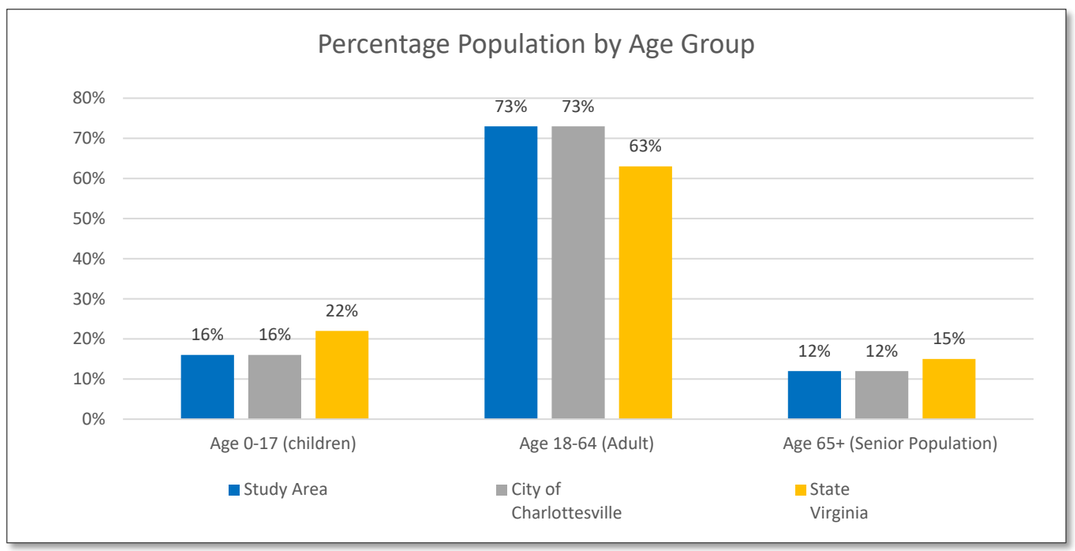


Figure 1-6. STEAP Tool Analysis Population by Age Group

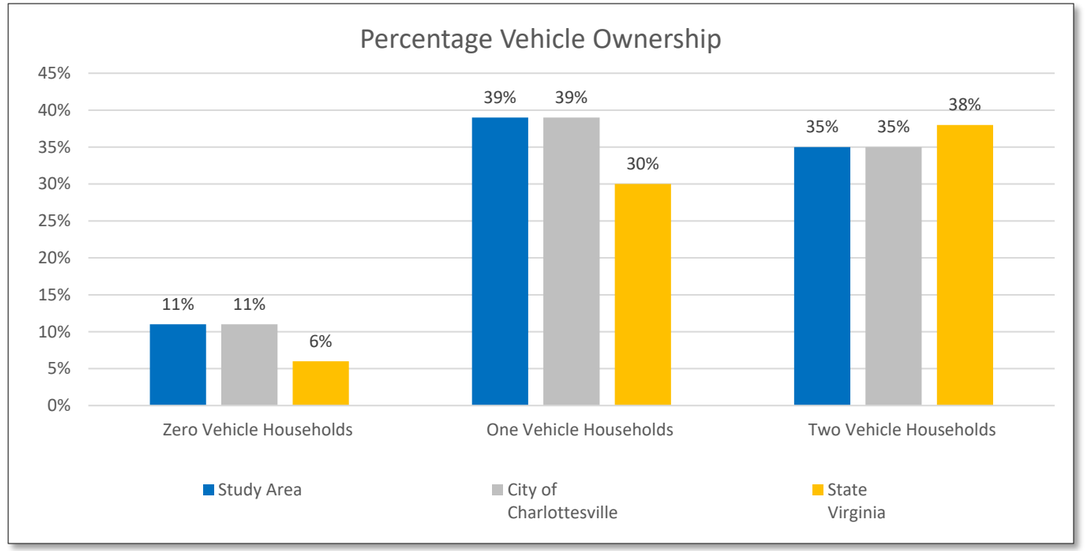


Figure 1-7. STEAP Tool Analysis Vehicle Ownership

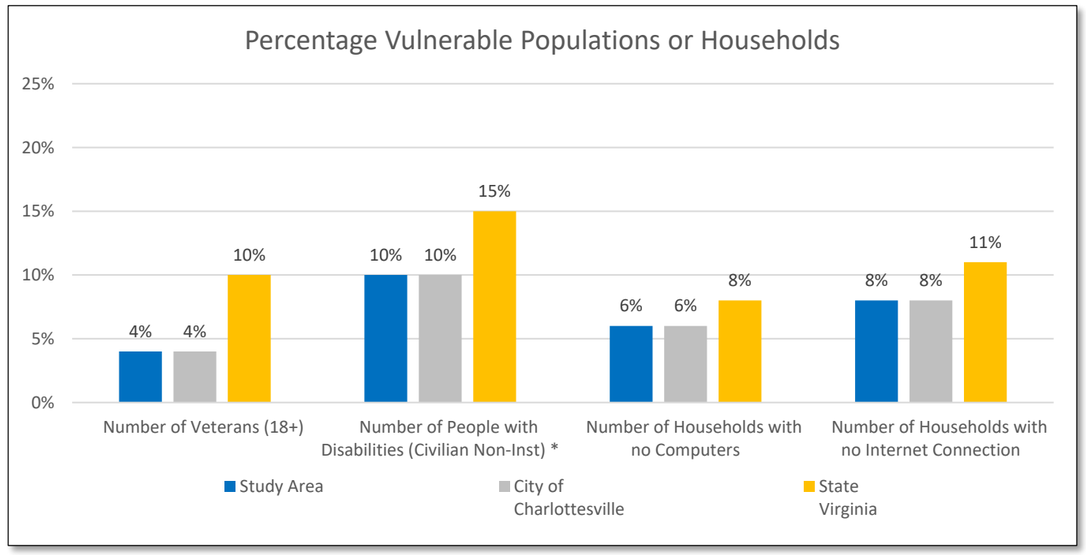


Figure 1-8. STEAP Tool Analysis Vulnerable Populations

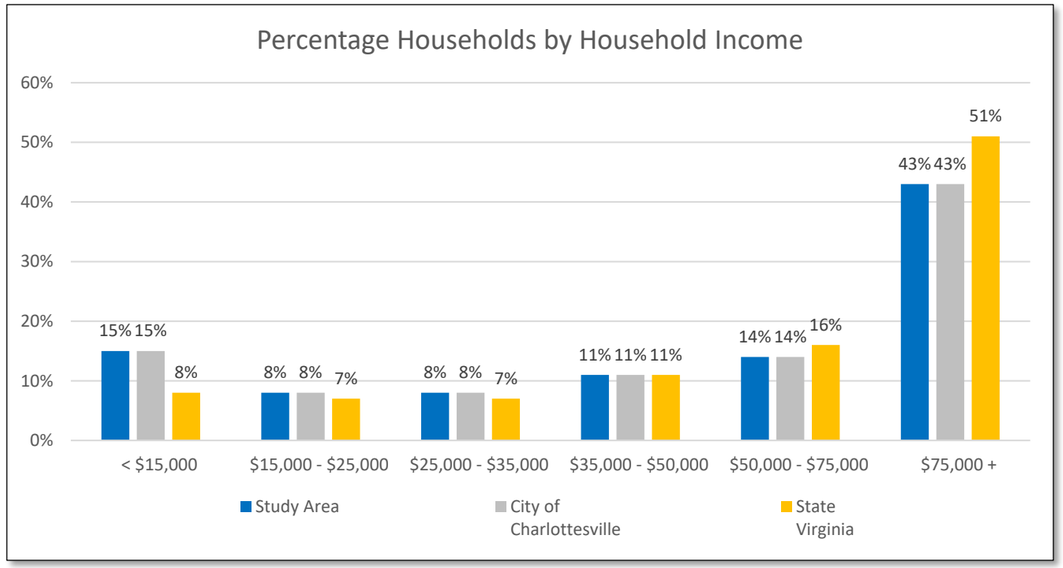


Figure 1-9. STEAP Tool Analysis Household Income

1.6 VTrans

VTrans is Virginia's statewide transportation plan. It is prepared for the Commonwealth Transportation Board (CTB) by the Office of Intermodal Planning and Investment (OIPI). VTrans lays out the overarching vision and goals for transportation in the Commonwealth and plans to achieve those goals. The VTRANS NEEDS for the Barracks Road corridor are presented in **Table 1-3.** Bicycle and safety improvement and Transit access are categorized as very high priority needs, Capacity preservation, Pedestrian access, and Transportation Demand Management are categorized as high priority needs. Transit access for equity emphasis areas is categorized as medium priority need.

Table 1-3. Barracks Road (Route 654) Corridor – VTrans NEEDS

VTRANS IDENTIFIED NEEDS	PRIORITIES
Bicycle Access	Very High
Capacity Preservation	High
Congestion Mitigation	None
IEDA (UDA) Access	None
Pedestrian Access	High
Safety Improvement	Very High
Pedestrian Safety Improvement	None
Reliability	None
Rail On-time Performance	None
Transit Access	Very High
Transit Access for Equity Emphasis Areas	Medium
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 1-10 presents a map of the study area with the 2019 VTrans mid-term needs prioritized for district construction. **Figure 1-11.** Project Overview for Barracks Road (Route 654) from Georgetown Road to Emmet St presents an overview map of the study area with the 2019 VTrans project overview for Barracks Road from Georgetown Road to Emmet St N.

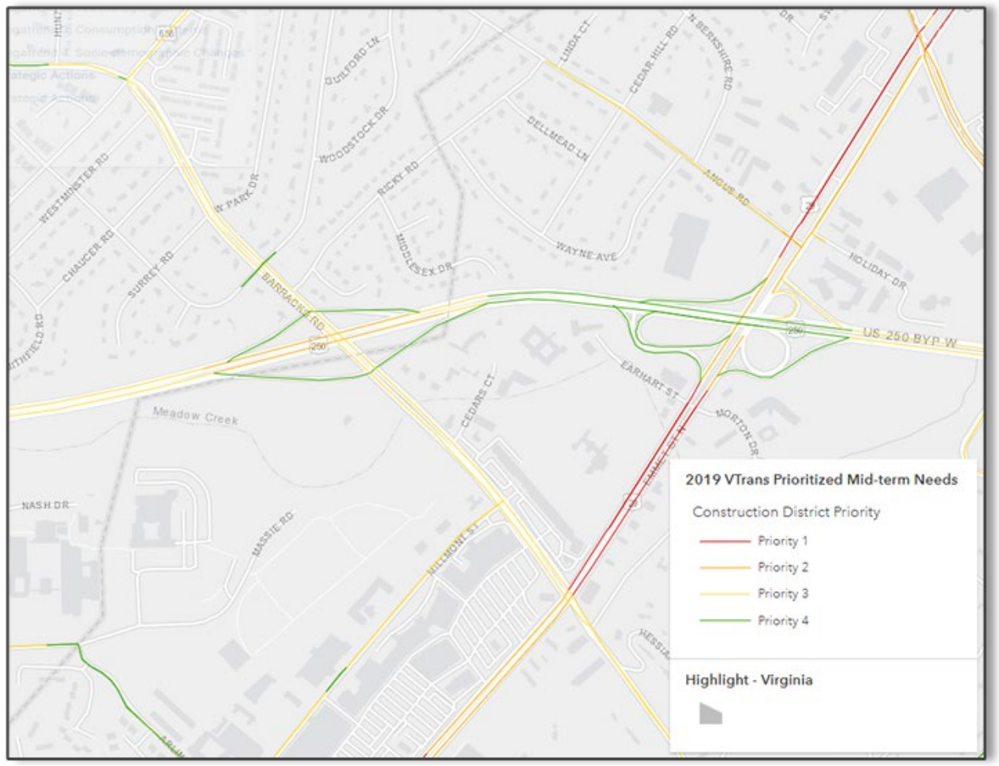


Figure 1-10. 2019 VTrans Prioritized Mid-term Needs in the Study Area

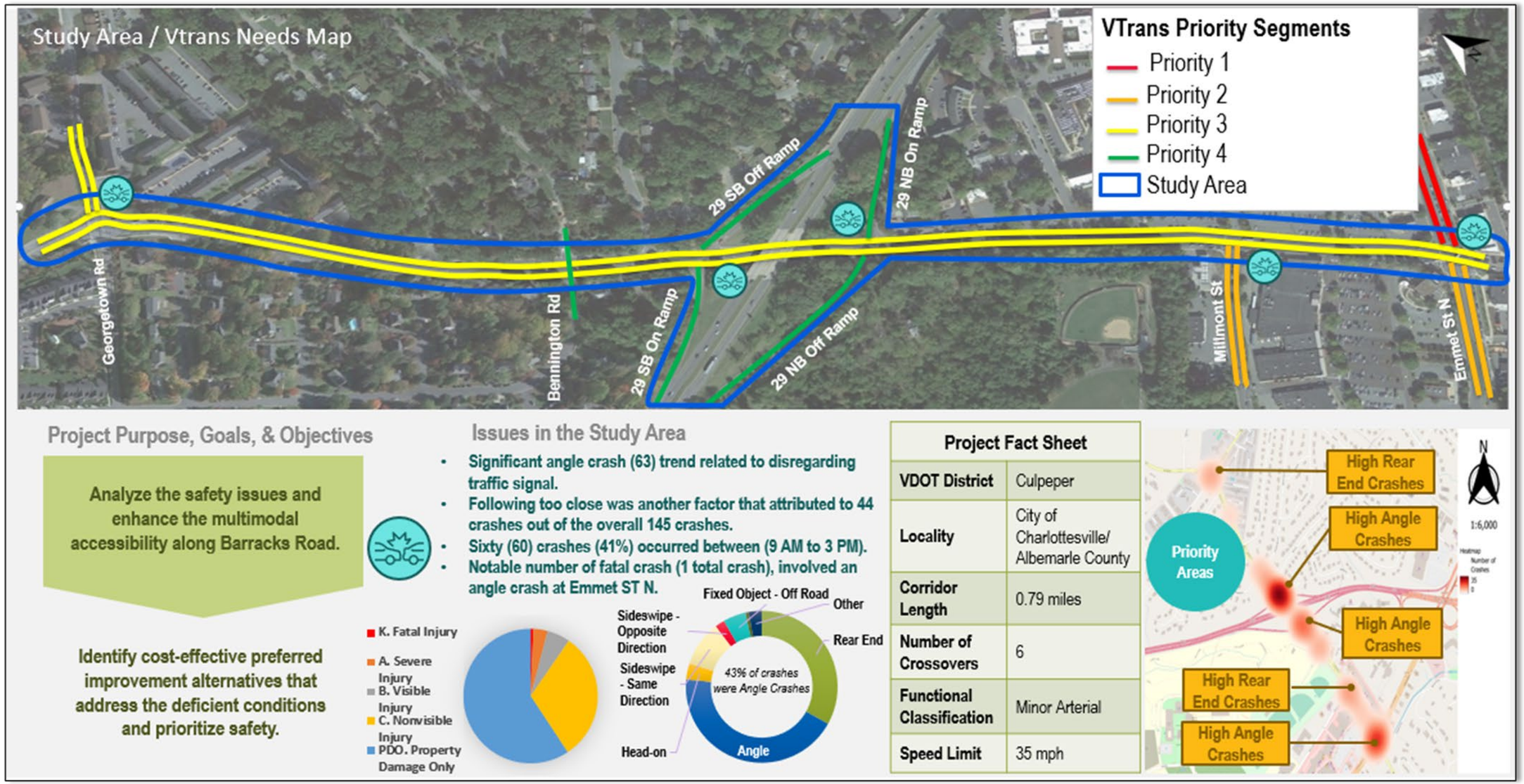


Figure 1-11. Project Overview for Barracks Road (Route 654) from Georgetown Road to Emmet St

1.7 Existing Conditions

Existing conditions evaluations were performed for the Barracks Road corridor in the City of Charlottesville/Albemarle County. The main goal was to identify safety, operations, and mobility issues that could be addressed within the Pipeline initiative scope of work. The existing conditions analysis for the study corridor includes the following items:

a) **Safety Performance**
b) **Field Visit**
c) **Data Collection and Traffic Operations**
d) **Corridor Level Analysis**
e) **Public Involvements Survey Results**

a. Safety Performance

A 5-year (2018 - 2022) safety analysis for the study area was conducted using the historical FR-300 crash data provided by VDOT. During the study period, one hundred and forty-five (145) crashes were reported in the study area, of which one hundred and thirty-four (134) occurred at or within 150 feet of an intersection, including intersections at the end of ramps. A summary of the Barracks Road (Route 654) crash analysis is presented in **Table 1-4**, and the corridor's crash map is shown in **Figure 1-12.** Raw crash data and FR300 crash diagram are provided in **Appendix B.**

- The reported crash history includes eighty-six (86) Property Damage Only (PDO) related crashes and fifty-nine (59) injury crashes. Of the fifty-nine (59) injury crashes, five (5) crashes were severe injury, and one (1) crash was fatal.
- The reported fatal crash occurred in August of 2020 in rainy conditions with a wet roadway surface at the intersection of US 29 Business (Emmet Street N) and Barracks Road. The fatal angle crash involved a southbound vehicle along US 29 Business colliding with a vehicle proceeding against a red light from the northbound US 29 Business left turn lane to Barracks Road. An unrestrained occupant of the southbound vehicle suffered a fatal injury. This intersection accounts for 50% of fatal and severe injury crashes that occurred along the corridor during the study period.
- The reported crashes include sixty-three (63) angle crashes (43%), forty-eight (48) rear-end crashes (33%), and seventeen (17) side swipe crashes (12%).
- During the study period, one hundred and forty-five (145) crashes were reported in the study area, of which one hundred and thirty-four (134) crashes (92%) occurred at or within 150 feet of an intersection. Below is a breakdown of crashes along the Barracks Road and each of the corresponding side street approaches:
    - Georgetown Road (Signalized)– 11 (8%)
    - Chaucer Road/Barracks Place (Stop Controlled) – 5 (3%)
    - Surrey Road/Park Drive (Stop Controlled) – 0 (0%)
    - Bennington Road (Stop Controlled) – 9 (6%)
    - Ricky Road (Stop Controlled) – 11 (8%)
    - US 29-250 SB Ramps (Signalized) – 36 (25%)
    - US 29-250 NB Ramps (Signalized) – 19 (13%)
    - Cedars Court (Stop Controlled) – 0 (0%)
    - Millmont Street (Signalized) – 13 (9%)
    - Emmet Street N (Signalized) – 30 (21%)
- "Following too close" and "did not have right of way" each attributed to forty-four (44) crashes (30%). "Disregarded traffic signal" also contributed to twenty-one (21) crashes (14%) including the fatal crash.
- Sixty (60) crashes (41%) occurred during the midday non-peak periods (between 9 AM to 3 PM), while eighteen (18) crashes (12%) and forty-three (43) crashes (30%) occurred during the typical AM (6 AM to 9 AM) and PM (3 PM to 6 PM) peak periods, respectively.
- Ten (10) crashes (7%) occurred during the AM peak hour (7:45 AM to 8:45 AM), and eleven (11) crashes (8%) occurred during the PM peak hour (4:15 PM to 5:15 PM)
- Although speeding was not found to be a significant (15 of 145 crashes, 10%) contributing factor to crashes, it was listed as a factor in two (2) of the five (5) severe injury crashes.
- Four (4) crashes (3%) involved drivers under the influence.
- Twenty-one (21) crashes (14%) occurred during adverse weather conditions, including the fatal crash.
- Three (3) crashes (2%), including the fatal crash and one severe injury crash, involved unbelted occupants.

From 2018-2022, 20% of crashes involved young drivers, while 31% involved senior drivers, accounting for 51% of the total crashes. For fatal and severe injury crashes, 17% involved young drivers, while 50% involved senior drivers.

Key takeaways from the crash data are as follows:

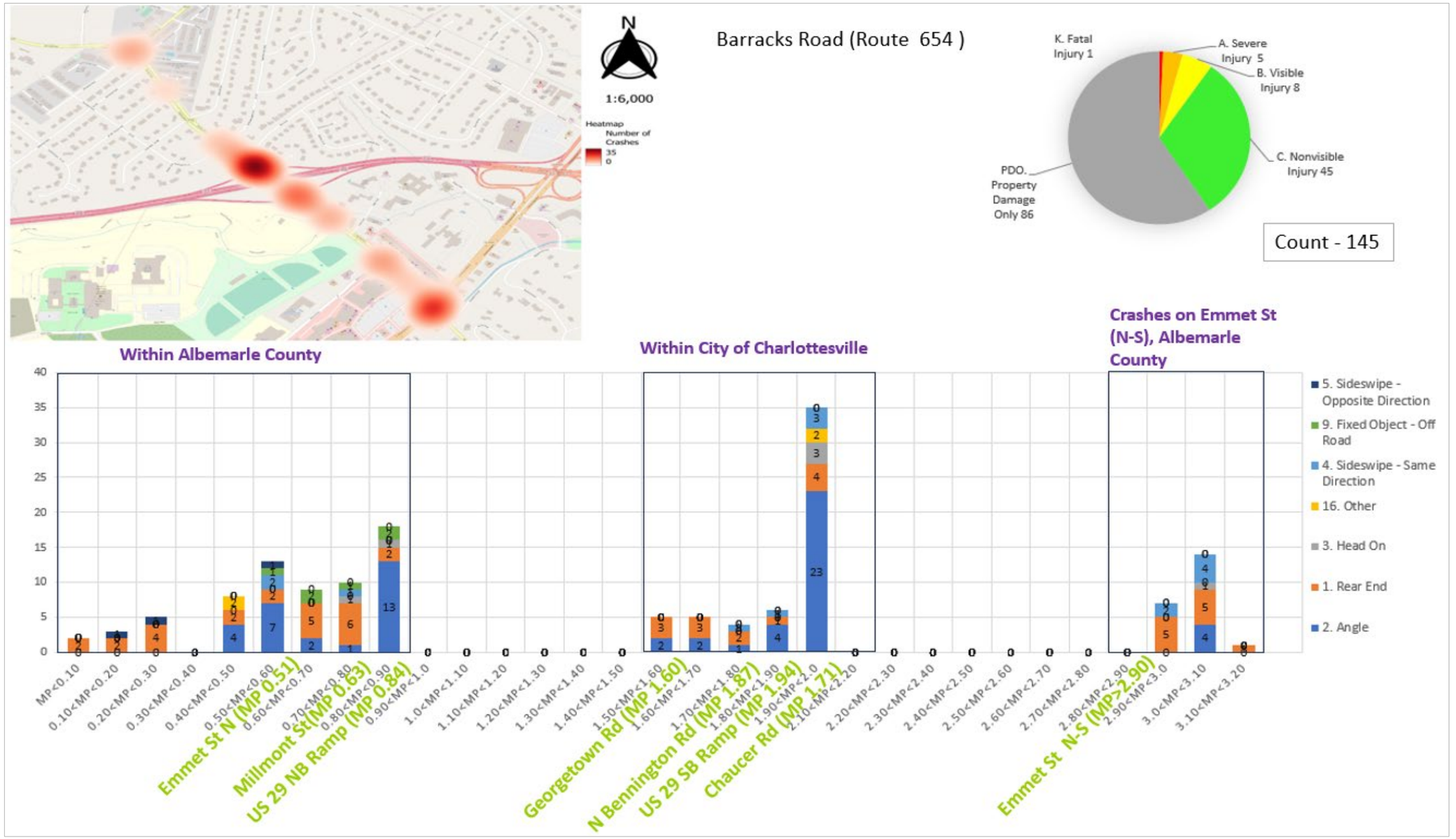
1. Year-over-year crash occurrence varies, with the highest number of crashes (33) occurring in 2018, followed by 32 in 2021.
2. The approximate average number of reported crashes per year is 29.
3. The majority of reported crashes within the corridor are Angle crashes. These constitute approximately 43% of the total crashes.

4. A total of 58 crashes were associated with injuries, accounting for approximately 40% of the reported crashes within the corridor. There was one crash that resulted in a fatality. The fatal crash occurred at the intersection of Barracks Road and Emmet Street N on a wet roadway where the northbound left turn vehicles ran a red light and were struck by a southbound through vehicle. An unrestrained occupant died as a result of the crash.
5. A total of 39 crashes (27%) occurred during the night.
6. There were 14 crashes (10%) that were due to speeding.
7. A senior driver was involved in 46 crashes (31%).

Table 1-4. Barracks Road (Route 654) – Crash Summary

	2018	2019	2020	2021	2022	5 Yr Total	Avg Crashes	%
1. Rear End	10	12	8	8	10	48	9.6	33%
2. Angle	14	12	15	16	6	63	12.6	43%
3. Head-on	1	0	0	2	2	5	1	3%
4. Sideswipe - Same Direction	4	1	3	3	3	14	2.8	10%
5. Sideswipe - Opposite Direction	0	0	2	1	0	3	0.6	2%
9. Fixed Object - Off Road	1	1	0	1	4	7	1.4	5%
10. Deer	0	0	0	0	1	1	0.2	1%
16. Other	3	0	0	1	0	4	0.8	3%
Total	33	26	28	32	26	145	29	-
K. Fatal Injury	0	0	1	0	0	1	0.2	1%
A. Severe Injury	0	1	1	1	2	5	1	3%
B. Visible Injury	2	3	0	1	2	8	1.6	6%
C. Nonvisible Injury	15	8	4	9	9	45	9	31%
PDO. Property Damage Only	16	14	22	21	13	86	17.2	59%
KAB	2	4	2	2	4	14	2.8	10%
1. Dawn	1	0	1	0	1	3	0.6	2%
2. Daylight	25	17	20	26	15	103	20.6	71%
3. Dusk	2	0	1	1	0	4	0.8	3%
4. Darkness - Road Lighted	1	4	4	4	10	23	4.6	16%
5. Darkness - Road Not Lighted	3	4	1	1	0	9	1.8	6%
6. Darkness - Unknown Road Lighting	1	1	1	0	0	3	0.6	2%
1. Dry	26	22	21	32	20	121	24.2	83%
2. Wet	6	4	7	0	6	23	4.6	16%
4. Icy	1	0	0	0	0	1	0.2	1%
0 - 3 AM	0	0	0	1	4	5	1	3%
3 - 6 AM	0	0	0	0	1	1	0.2	1%
6 - 9 AM	6	3	3	3	1	16	3.2	11%
9 AM - 12 PM	6	2	5	9	2	24	4.8	17%
12 - 3 PM	7	1	7	7	6	28	5.6	19%
3 - 6 PM	8	13	5	7	4	37	7.4	26%
6 - 9 PM	6	5	6	5	6	28	5.6	19%
9 PM - 12 AM	0	2	2	0	2	6	1.2	4%
Speeding	3	1	2	5	4	15	3	10%
Not Speeding	30	25	26	27	22	130	26	90%
Young Driver (<21)	4	4	7	7	7	29	5.8	20%
Senior Driver (>65)	9	6	10	12	8	45	9	31%

Figure 1-12. Barracks Road (Route 654) – Locations and Crash Types



b. Field Visit

A field visit to the project corridor was performed on Wednesday, August 16, 2023, from 7:00 to 9:00 in the AM peak hour and 4:00 to 5:30 in the PM peak. The following observations were noted for the corridor:

- Barracks Road at Emmet Street N
  - There is no intersection lighting; some street lighting is adjacent to the intersection on Route 29, with a 35 mph speed limit on this intersection's east/west sides.
  - Signal Timing: Signalized. Barracks Road is split phased. The signal is very old.
  - Pedestrian Activity / Amenities: There are 4 high-visibility crosswalks with pedestrian signals and audible communications.5-foot sidewalks on Barracks Road. Continuous sidewalk on the north/east side of the road. On the south/west side of the road, there is a sidewalk from Emmet Street N to just south of the NB Bypass.
- Barracks Road at Millmont Street
  - Lane Configuration: Two through lanes with left for the EB and WB approaches.
  - Signal Timing: WBL is protected only with signal heads on pedestals. NB & SB are split phased. The signal is very old.
  - Pedestrian Activity / Amenities: 2 pedestrian crosswalks with high-visibility markings on W and N legs. There is no pedestrian signal for crossing Millmont Street.
- Barrack Road at US 29 NB Ramp
  - Lane Configuration: Two through lanes with a left for the EB and two through lanes for the WB approach.
  - Barracks Road through movements at the two ramp intersections do run concurrently.
  - Pedestrian Activity / Amenities: Missing crosswalk markings
  - pedestrian activities at the intersection.
- Barrack Road at US 29 SB Ramp
  - Lane Configuration: NB & SB ramps phases are different phases (they don't run concurrently.
  - Barracks Road through movements at the two ramp intersections do run concurrently.
  - Pedestrian Activity / Amenities: Missing crosswalk markings on the north side of Barracks Road.
- Barracks Road at Georgetown Road
  - Signal Timing: Side street approaches from NB & SB approaches are split phased. Left turn movements are protected during the left turn (arrow) signal indication and permitted during the green ball.
  - Pedestrian Activity / Amenities: 3 pedestrian crosswalks with high-visibility markings on north, south, and west legs. Pedestrian signals, crosswalks, and ADA ramps were observed for all 4 legs of the intersection.

c. Data Collection and Traffic Operations Analysis

The traffic data for the study area was obtained from turning movement counts collected on Thursday, May 25, 2023. 12-hour (6:00 AM – 6:00 PM) turning movement counts (TMC) were collected at the study area intersections. Raw traffic counts are provided in **Appendix C.** The corridor AM peak hour was determined to be 7:00 AM to 8:00 AM, and the corridor PM peak hour was determined to be 4:00 PM to 5:00 PM. **Figure 1-13, Figure 1-14, and Figure 1-15** presents the peak hour volume diagrams for the Existing Conditions 2023 and provided in **Appendix D**.

Synchro (Version 11) was utilized to evaluate the average intersection delay per vehicle and level of service (LOS). *SimTraffic* was utilized to perform queueing analysis to determine maximum queue length. The results were based on an average of ten (10) simulation runs. The study intersections currently operate on demand during both the AM and PM peak hours. **Appendix E** provides the *Synchro/SimTraffic* output reports.

The Synchro/*SimTraffic* analysis results for the existing conditions are presented **Table 1-5** and **Table 1-6**. Overall, the Barracks Road corridor capacity results vary for the signalized intersections. The signalized intersection level of service (LOS) ranges from C to F. Many unsignalized intersections operate with poor LOS on the side street left turn movements. Traffic analysis results are provided in **Appendix E.** All the unsignalized turning movements to and from the side streets are low (less than 50 vph). The following sections present the analysis results:

- The signalized intersections operate at an overall LOS D or better during peak hours. However, the following approaches fail at LOS E/F during at least one peak hour:
  - Georgetown Road Northbound at Barracks Road for both peak hours
  - Georgetown Road Southbound at Barracks Road (PM)
  - US29/ US 250 Southbound at Barracks Road (PM)
  - US29/ US 250 Northbound at Barracks Road (PM)
- The individual movements at the unsignalized intersections operate at LOS D or better during both peak hours, except for the following approaches that fail at LOS E/F during at least one peak hour:
  - Chaucer Road southbound at Barracks Road experiences a lower level of service, specifically LOS E during the AM peak hour and LOS F during the PM peak hour
  - Surrey Road southbound at Barracks Road experiences a lower level of service, specifically LOS F, during both peak hours

- Bennington Road southbound at Barracks Road experiences a lower level of service, specifically LOS F, during both peak hours.

- Ricky Road southbound at Barracks Road experiences a lower level of service, specifically LOS E, during both peak hours.

In summary, Synchro/SimTraffic modeling shows comparable results for each intersection's most critical queuing in the network. For example, the northbound ramp at Barracks Road spills out of its turn lane (approximately 1,028 feet of storage) back to the US 29/US 250 ramp. The two analysis tools display this extreme queuing pattern in the PM peak hour with similar results.

Figure 1-13. Barracks Road (Route 654) – Existing Conditions Peak Hour Volumes (1 of 3)

Figure 1-14. Barracks Road (Route 654) – Existing Conditions Peak Hour Volumes (2 of 3)

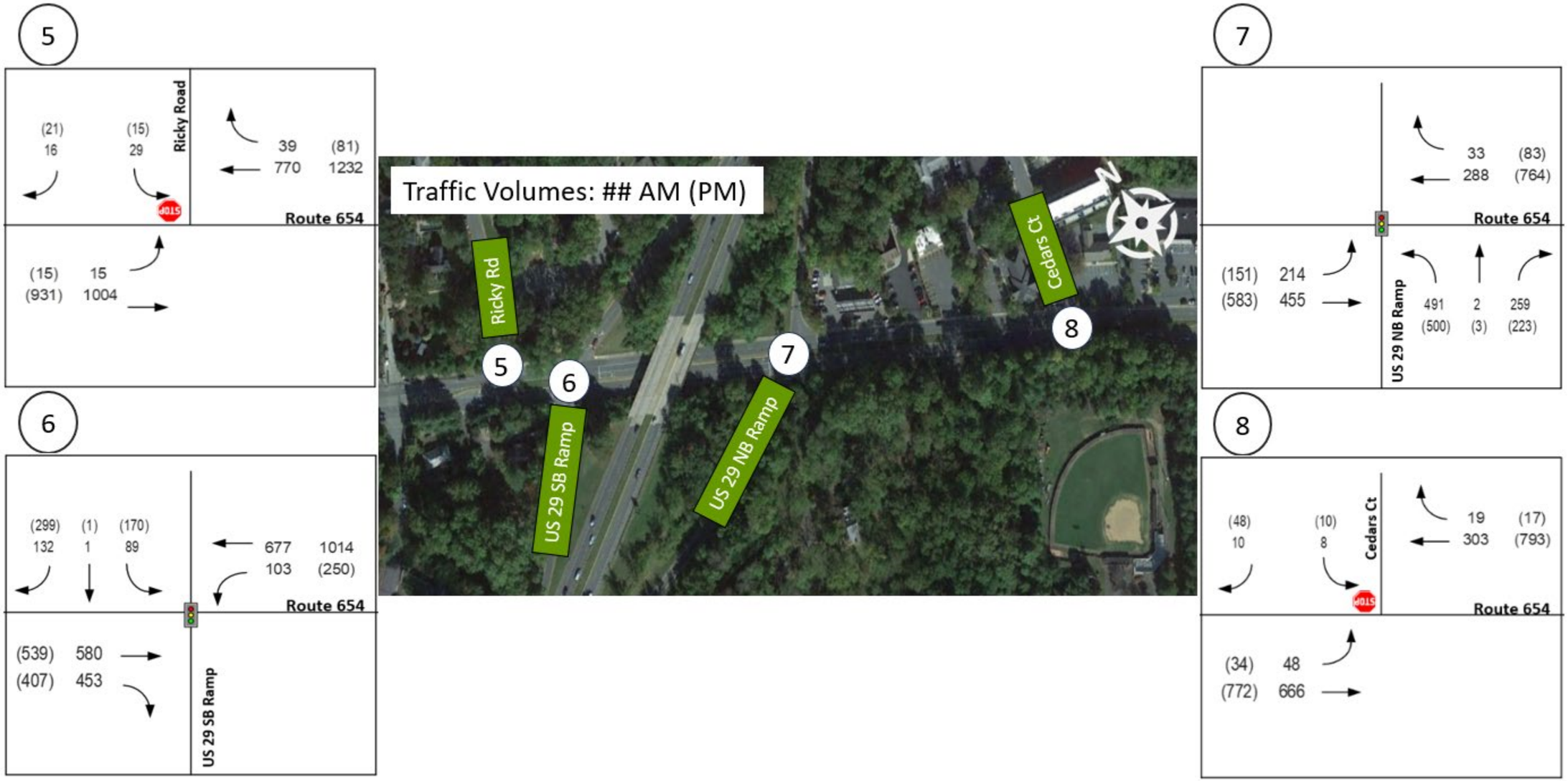


Figure 1-15. Barracks Road (Route 654) – Existing Conditions Peak Hour Volumes (3 of 3)

Table 1-5. Barracks Road (Route 654) – Existing Conditions Intersection Analysis Results (1 of 2)

Intersection	Approach	HCM EC 2023 Delay (sec/veh)		EC 2023 HCM LOS		Sim Traffic EC 2023 Delay (sec/veh)		NB 2023 SIM Traffic LOS		EC 2023 95th % (ft.)		EC 2023 Queue Max (ft.)		Storage (ft.)
Barracks Rd at Georgetown Rd -Signalized-	Northbound	58.6	69.0	E	E	54.8	65.8	D	E	40	26	170	170	170
	Westbound	34.1	36.8	C	D	33.6	30.1	C	C	369	522	583	482	
	Southbound	50.7	95.0	D	F	31.7	71.7	C	E	368	#622	83	85	170
	Eastbound	26.9	20.3	C	C	30.1	29.7	C	C	566	#580	392	587	
	Overall	37.1	52.4	D	D	24.4	32.2	C	C					
Barracks Rd at 29 SB Off Ramp -Signalized-	Westbound	7.2	21.2	A	C	24.2	22.3	C	C	m134	#350	89	279	
	Southbound	46.0	60.6	D	E	53.8	80.5	D	F	131	255	174	312	
	Eastbound	4.3	6.6	A	A	7.3	19.9	A	B	106	126	130	172	165
	Overall	10.0	22.9	A	C	8.5	17.6	A	B					
Barracks Rd at 29 NB Off Ramp -Signalized-	Northbound	41.6	74.8	D	E	93.5	107.3	F	F	134	350	799	1,028	215
	Westbound	33.1	40.1	C	D	22.9	34.5	C	C	85	286	175	428	
	Eastbound	42.4	42.0	D	D	39.1	64.8	D	E	#316	m244	270	295	
	Overall	40.3	51.6	D	D	29.6	50.3	C	D					
Barracks Rd at Millmont St -Signalized-	Northbound	33.2	40.3	C	D	38.4	38.3	D	D	115	352	118	160	160
	Westbound	25.8	34.8	C	C	39.0	52.7	D	D	68	150	160	160	160
	Southbound	21.5	34.6	C	C	24.0	37.3	C	D	23	80	389	434	
	Eastbound	26.7	36.7	C	D	22.9	25.5	C	C	150	203	106	181	235
	Overall	27.6	37.3	C	D	19.4	31.5	B	C					
Barracks Rd at Emmet St N -Signalized-	Northbound	35.8	46.6	D	D	50.4	62.9	D	E	70	128	197	381	350
	Westbound	41.0	62.2	D	E	40.9	76.9	D	E	156	#318	222	378	
	Southbound	31.3	34.0	C	C	43.5	56.1	D	E	252	365	328	290	150
	Eastbound	34.0	67.7	C	E	51.4	119.0	D	F	#372	#585	411	552	200
	Overall	34.1	50.1	C	D	30.4	51.8	C	D					

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F respectively.
*HCM 2000 Methodology
95th percentile volume exceeds capacity; queue may be longer.

Table 1-6. Barracks Road (Route 654) – Existing Conditions Intersection Analysis Results (2 of 2)

No.	Intersection	Approach	HCM EC 2023 Delay (sec/veh)		EC 2023 HCM LOS		Sim Traffic EC 2023 Delay (sec/veh)		NB 2023 SIM Traffic LOS		EC 2023 95th % (ft.)		EC 2023 Queue Max (ft.)		Storage (ft.)
6	Barracks Rd at Chaucer Rd -TWSC-	Northbound	13.2	11.7	B	B	7.9	6.5	A	A	3	0	51	32	145
		Westbound	0.2	0.1	A	A	7.8	10.5	A	B	3	3	33	26	
		Southbound	40.6	65.3	E	F	31.1	53.4	D	F	10	10	57	40	
		Eastbound	0.0	0.0	A	A	4.4	4.2	A	A	0	0	11	7	115
7	Barracks Rd at Surrey Rd -TWSC-	Northbound	22.8	20.9	C	C	24.1	6.6	C	A	5	3	47	30	150
		Westbound	0.1	0.2	A	A	5.7	9.3	A	A	3	3	34	13	
		Southbound	57.7	64.4	F	F	34.6	53.8	D	F	18	13	64	46	
		Eastbound	0.0	0.1	A	A	2.3	11.3	A	B	0	0	8	33	135
8	Barracks Rd at Bennington Rd -TWSC-	Northbound	24.1	16.3	C	C	29.6	17.9	D	C	5	3	36	62	130
		Westbound	0.2	0.3	A	A	7.8	10.7	A	B	3	5	32	56	
		Southbound	57.7	131.8	F	F	45.8	129.5	E	F	30	43	85	141	
		Eastbound	0.0	0.1	A	A	3.5	8.6	A	A	0	0	62	194	105
9	Barracks Rd at Ricky Rd -TWSC-	Westbound	0.0	0.0	A	A	0.7	0.9	A	A	0	0	15	20	60
		Southbound	38.9	44.8	E	E	84.5	658.5	F	F	33	28	178	350	
		Eastbound	0.1	0.2	A	A	3.9	8.5	A	A	3	0	205	262	
10	Barracks Rd at Cedars Ct -TWSC-	Westbound	0.0	0.1	A	A	1.5	1.9	A	A	0	0	33	26	110
		Southbound	13.0	16.6	B	C	15.7	24.6	C	C	3	15	57	40	
		Eastbound	0.6	0.5	A	A	4.4	2.9	A	A	3	5	11	7	

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F respectively.
*HCM 6th Ed Methodology
95th percentile volume exceeds capacity; queue may be longer.

e. Corridor Level Analysis

The analysis utilized data from the INRIX platform to estimate the average travel time index and average speed profiles along the eastbound and westbound directions of the Barracks Road study corridor for the year 2023 conditions. April was assumed to be the best representative of the travel conditions during the year; therefore, the metrics were collected for this month.

The corridor analysis results in **Figure 1-16** indicate that travel time along the westbound direction of Barracks Road is higher than the free-flow conditions from 3 PM to 5 PM. During the AM, from 6 to 8 peak period, the travel time westbound averages 224s, and eastbound averages 230s, which match the free-flow conditions. In addition, average speeds along the corridor drop to lower than 27 MPH in both directions. During the PM peak, the average travel time is approximately 305s (eastbound) and 289s (westbound), slightly lower than the free-flow conditions. Therefore, average speeds along the corridor drop to approximately 20 MPH in both direction

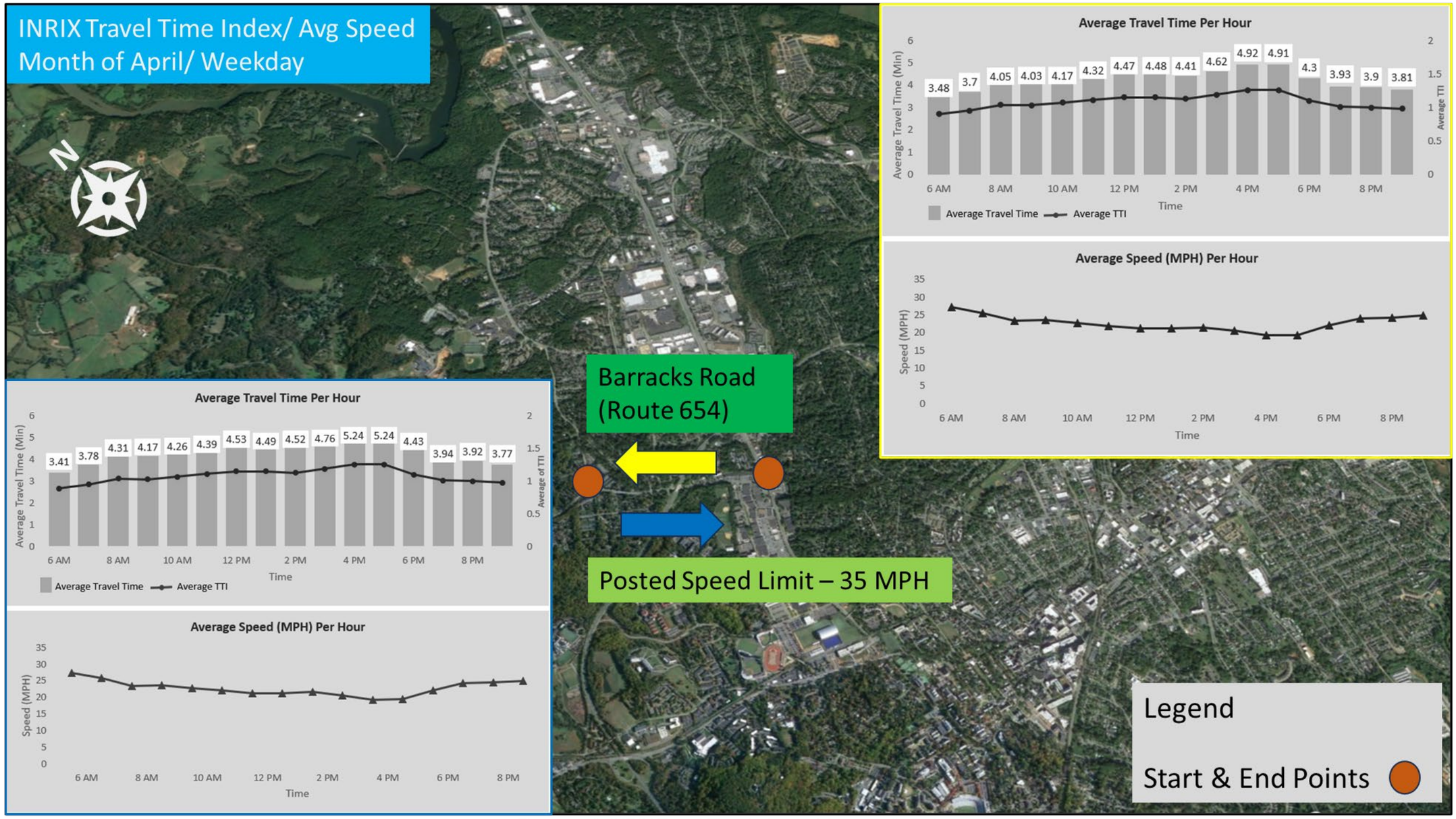


Figure 1-16. INRIX Travel Time Index and Average Speed

f. Public Involvement Survey Results – Existing Conditions

Initial public outreach was conducted to inform the public of the study efforts and goals and solicit feedback on what the public's priorities and perceptions of the corridor are to include in the evaluation of potential alternatives. The survey was conducted through Publicinput.com, and there were 846 participants. The raw results of the public survey are provided in **Appendix F**.

The survey shows that the major needs of the corridor include safety, bicycle and pedestrian accessibility/connectivity, and transit accessibility/connectivity, as shown in **Figure 1-17** presents a chart summarizing the survey responses.

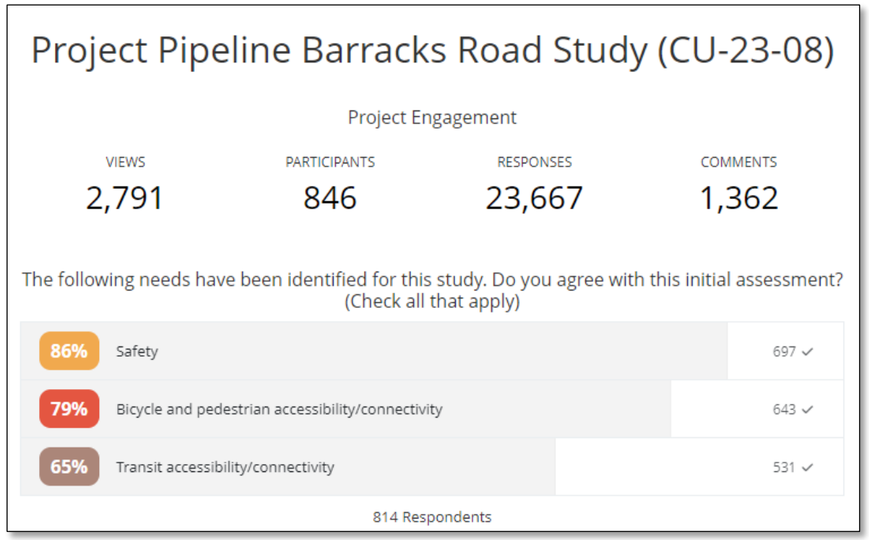


Figure 1-17. Barracks Road (Route 654) – Public Input Survey Results

Figure 1-18 shows the written comment issues along the corridor that needed to be addressed. **Figure 1-19** summarizes the key survey responses to issues along the corridor, including pedestrian safety, traffic congestion, bicycle safety, and overall corridor safety. Most respondents use the corridor for shopping/errands, passing through, or traveling to work. Additionally, 96% of the respondents travel using personal vehicles, and 72% of respondents agree that crosswalks/pedestrian signals are needed along this corridor.

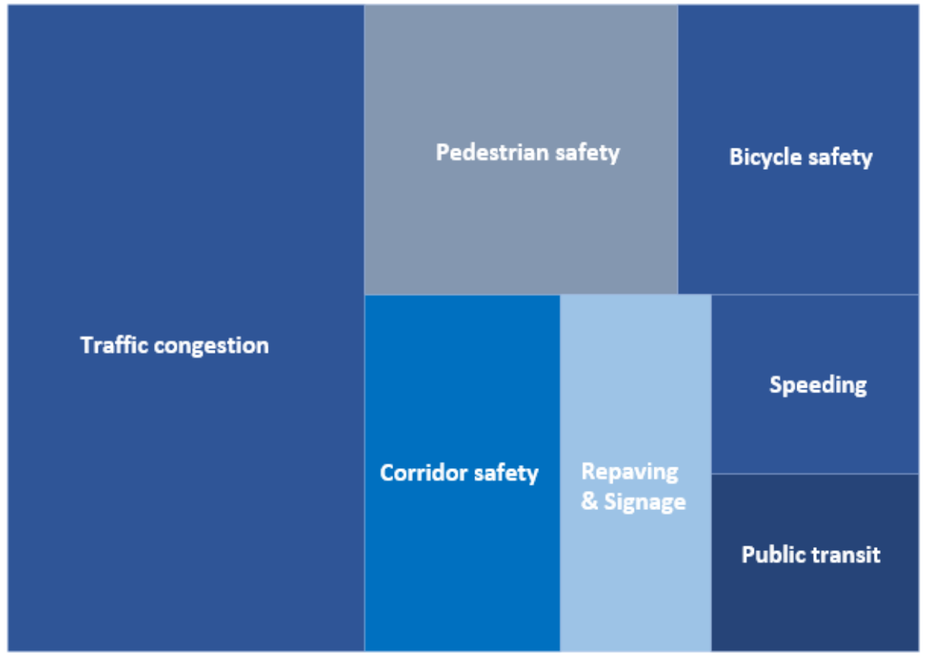


Figure 1-18. Barracks Road (Route 654) – Issues along the Study Corridor

The notable comments from the survey responses are summarized below:

- Making left turns at unsignalized intersections is difficult, especially at the intersection of Ricky Road and Bennington Road. There have been 5 Angle crashes reported at Ricky Road, which resulted in visible injury.
- High volumes cause moderate traffic congestion at the following intersections Georgetown Road, Millmont Street, and Emmet Street N.
- There is a lack of crosswalks/ pedestrian signals along the corridor, especially at the Millmont Street south leg.

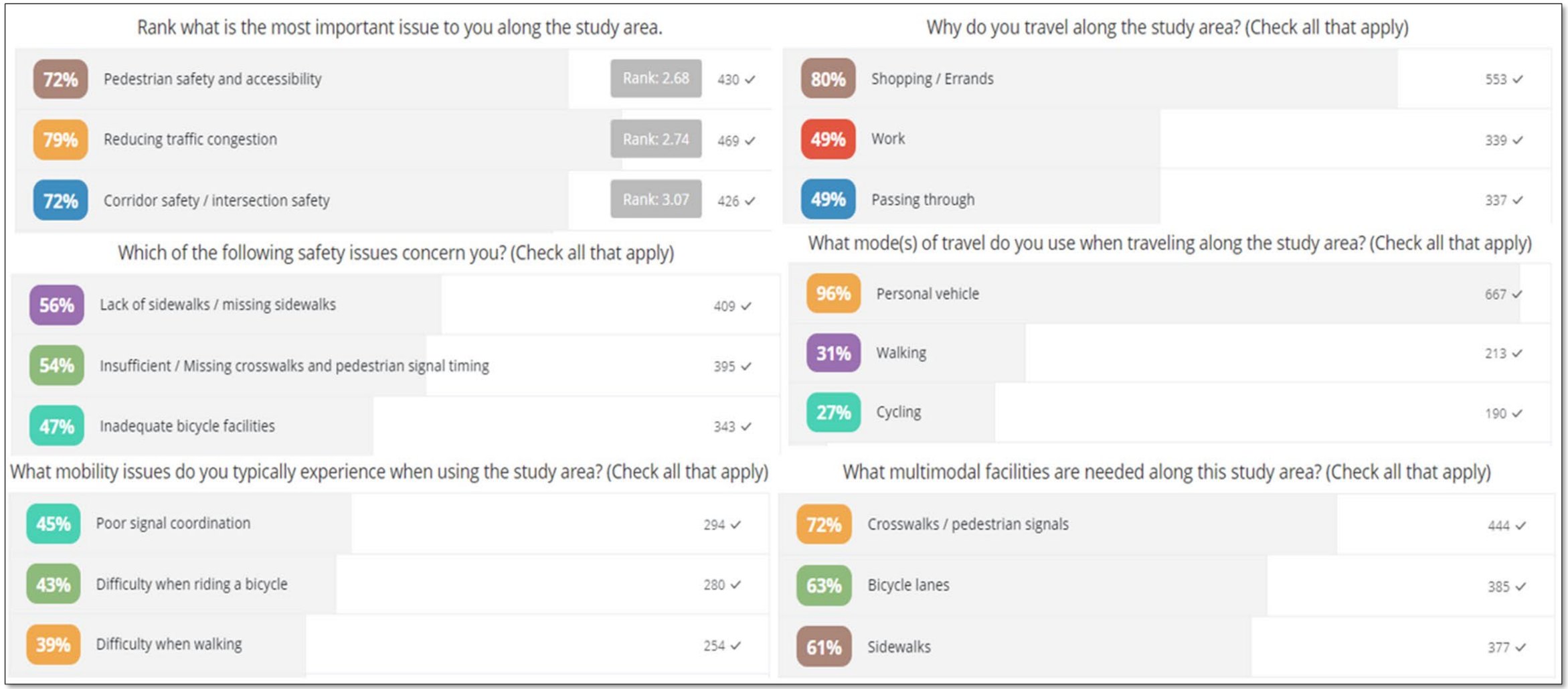


Figure 1-19. Barracks Road (Route 654) – Public Input Survey Responses

1.8 Traffic Forecast

The design year for this project is 2045, and the interim year is 2035. To estimate growth rates for the future year scenarios, we reviewed three data sources: the available VDOT historical AADT data, VDOT's Statewide Planning System (SPS) data through Pathways for Planning, and the Charlottesville/Albemarle Regional Travel Demand Model (TDM). All traffic growth rate calculations use linear methodologies because the historical trend has demonstrated consistent small linear growth rates. The three traffic data sources were reviewed to develop the recommended growth rates listed below:

- 2045 Charlottesville/Albemarle Regional TDM Model
- Statewide Planning System (SPS) Data, and
- Historical Growth Trends

Recommended growth rates were used to develop average daily traffic (ADT) and AM and PM peak hour volumes for the Design (2045) year conditions. The future year conditions were based on improvements and socio-economic data coded into the (2045) travel demand model network. Given that the proposed improvements are focused on spot improvements and addressing operational and safety concerns, capacity expansion was not anticipated. So, one set of volumes for the future year was developed for both No Build and Build conditions.

a. Model Outputs

Model volume outputs for model years 2015 and 2045 were tabulated, and a growth rate was calculated for the segment. The base year (2015) TDM volumes did meet the VDOT volume validation limits specified in the VDOT Travel Demand Modeling Policies and Procedures (version 3.0). Therefore, the TDM data should be considered with caution. The TDM forecasts were adjusted using the ratio and difference methods; then, the two adjusted forecasts were averaged. The Charlottesville/Albemarle TDM annual growth rates ranged from -0.59% to 1.39% annually on the study area roads. Annual growth on Barracks Road ranged from 0.13% to 1.10%. Growth rates on the major intersecting streets ranged from -0.59% to 1.39% annually. Detailed model output volumes for each project segment are included in **Appendix C**.

b. Growth Rate Comparison

Growth rates from the model outputs were compared to those from SPS and historical trends. Engineering judgment was used to determine the recommended growth rates. Growth rate comparisons and the final recommended growth rates for each project segment are presented in **Table 1-7.**

c. Future Years 2035 & 2045 Forecast

The recommendation is for modest annual growth rates on Barracks Road and the intersecting roads in line with all three forecasting methods. Barracks Road's final recommended annual growth rates range from 0.50% to 1.20% (west of Georgetown Road). All intersecting streets are recommended to be grown at 0.5% annually. Many growth rates are set to 0.5% annually to meet the minimum recommended growth rate in VDOT's Forecasting Guidebook.

The recommended growth rates are applied to the existing peak hour volumes to estimate future 2035 and 2045 peak hour volumes. The balanced peak hour volumes for No Build 2035 are shown in **Figure 1-20, Figure 1-21, Figure 1-22,** and No Build 2045 is shown in **Figure 1-23, Figure 1-24,** and **Figure 1-25.**

Table 1-7. Barracks Road (Route 654) – Growth Rate Comparison & Recommended Growth Rate

Project	Segment Location	VDOT Historical Linear Regression Annual Growth Rate (2010-2019)	VDOT SPS Linear Regression Annual Growth Rate (2022-2050)	Average Ratio & Difference Method Linear Annual Growth Rate (2015-2045)	Final Recommended Annual Growth Rates
Road	East of Emmet St	0.46%	0.50%	0.13%	0.50%
Barracks Road	Emmet St to 29/250 Bypass	0.10%	0.50%	0.33%	0.50%
Barracks Road	29/250 Bypass to Georgetown Rd	0.98%	0.50%	0.58%	1.00%
Barracks Road	West of Georgetown Rd	2.01%	0.50%	1.10%	1.20%
Barracks Road	North of Barracks Rd	-0.33%	0.50%	0.13%	0.50%
	South of Barracks Rd	-0.49%	0.50%	0.23%	0.50%
Emmet St	South of Barracks Rd	-0.20%	0.50%	0.08%	0.50%
	N/A	N/A	0.50%	-0.14%	0.50%
Millmont St	N/A	N/A	N/A	-0.46%	0.50%
EB/NB Bypass Off-ramp	N/A	N/A	0.50%	1.39%	0.50%
EB/NB Bypass On-ramp	N/A	N/A	0.50%	-0.59%	0.50%
WB/SB Bypass Off-ramp	North of Barracks Rd	-1.06%	0.55%	1.27%	0.50%
WB/SB Bypass On-ramp	South of Barracks Rd	-2.10%	0.55%	N/A	0.50%
Ricky Road	North of Barracks Rd	-4.42%	0.55%	N/A	0.50%
Bennington Rd	South of Barracks Rd	-2.78%	0.56%	N/A	0.50%
Bennington Rd	North of Barracks Rd	-4.24%	0.55%	N/A	0.50%
Surrey Rd	South of Barracks Rd	-2.22%	0.56%	N/A	0.50%
W Park Dr	North of Barracks Rd	0.24%	0.50%	0.39%	0.50%

Figure 1-20. Barracks Road (Route 654) – 2035 Balanced Peak Hour Volumes (1 of 3)

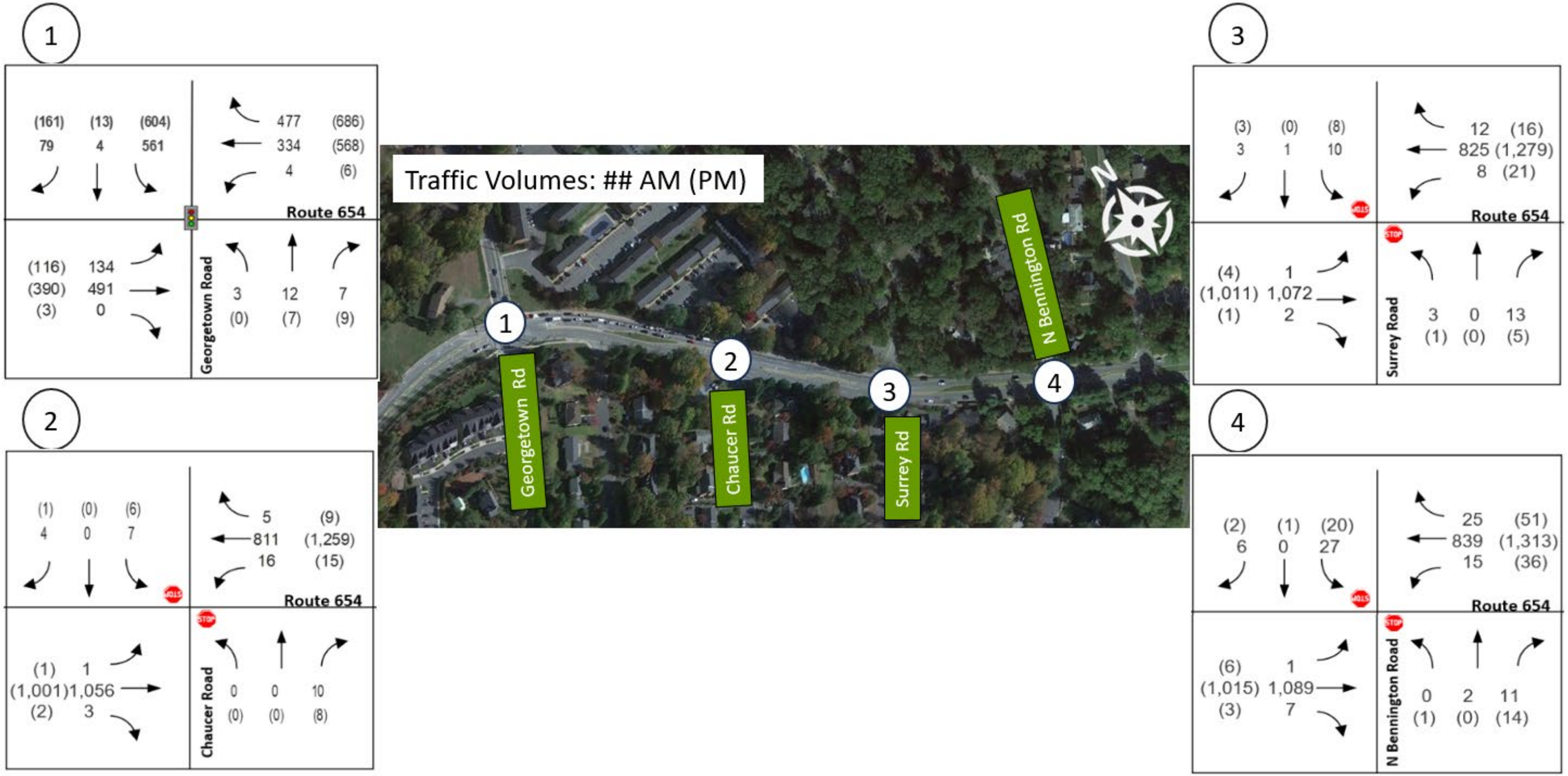


Figure 1-21. Barracks Road (Route 654) – 2035 Balanced Peak Hour Volumes (2 of 3)

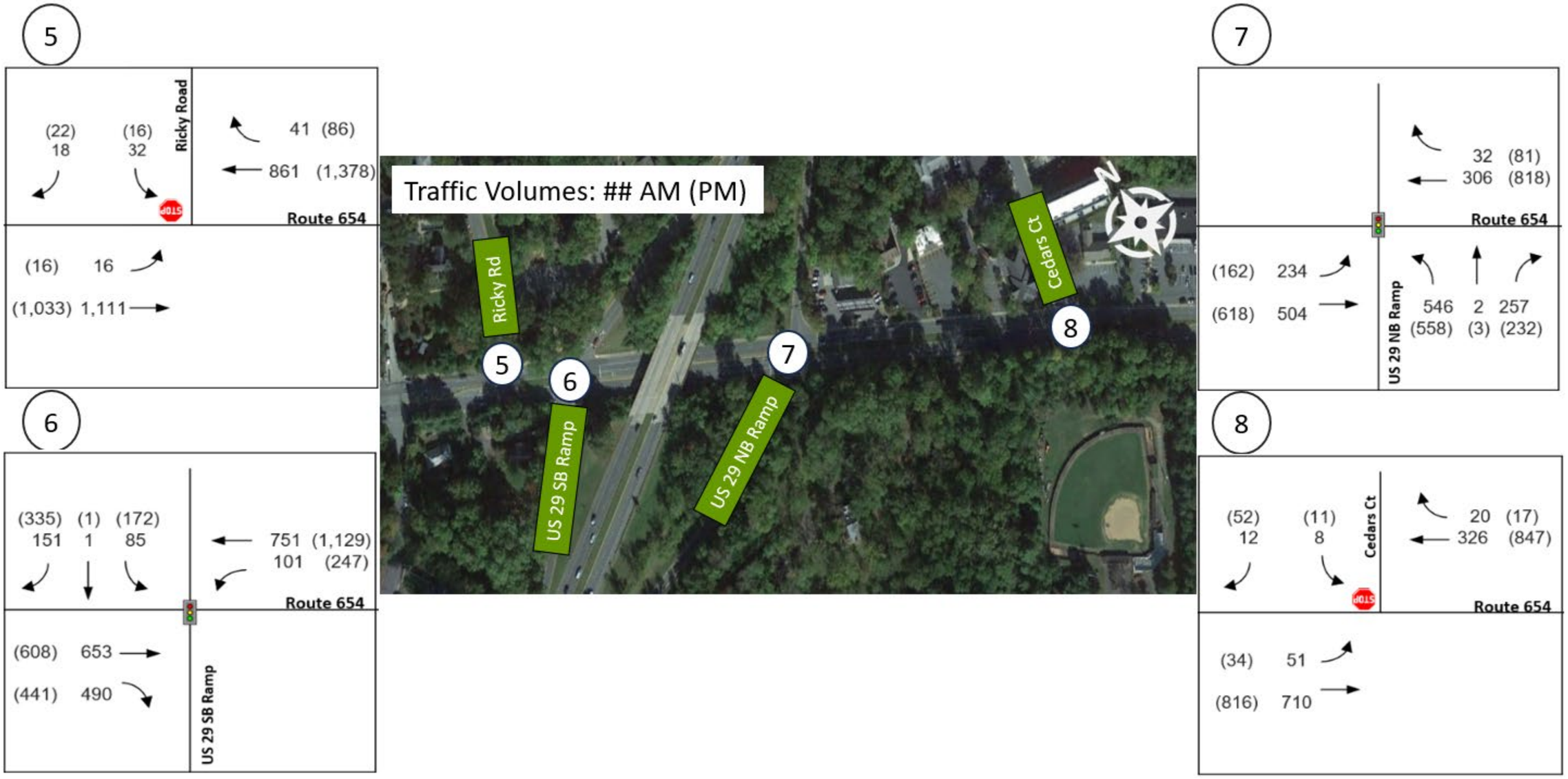


Figure 1-22. Barracks Road (Route 654) – 2035 Balanced Peak Hour Volumes (3 of 3)

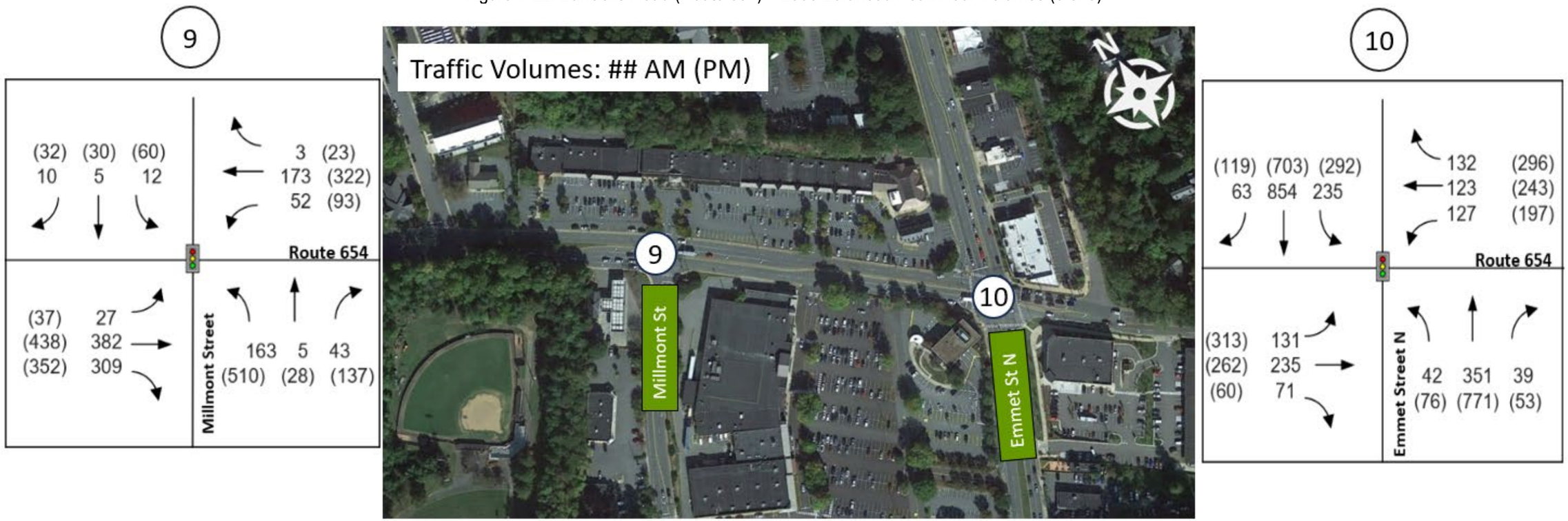


Figure 1-23. Barracks Road (Route 654) – 2045 Balanced Peak Hour Volumes (1 of 3)

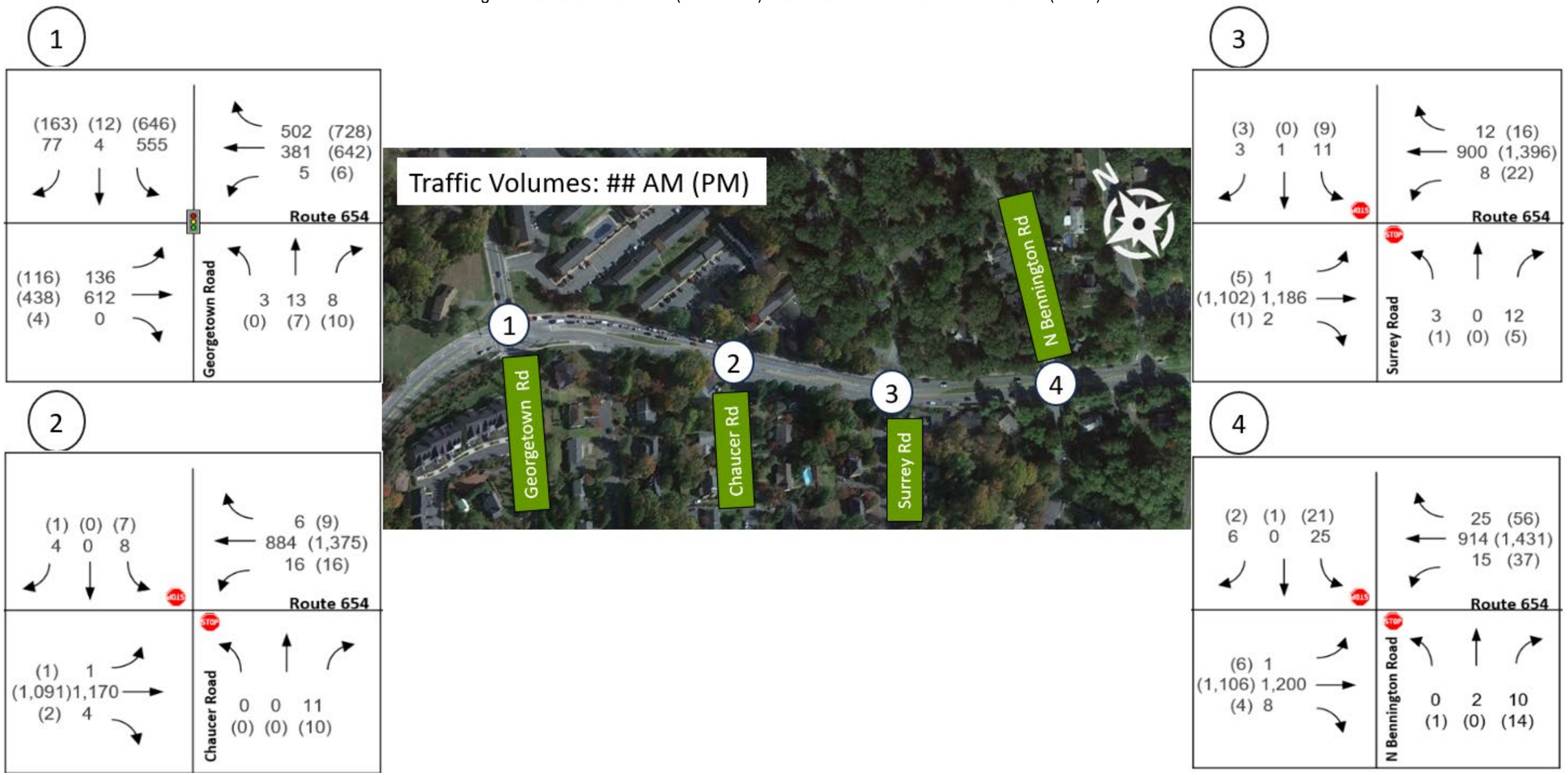


Figure 1-24. Barracks Road (Route 654) – 2045 Balanced Peak Hour Volumes (2 of 3)

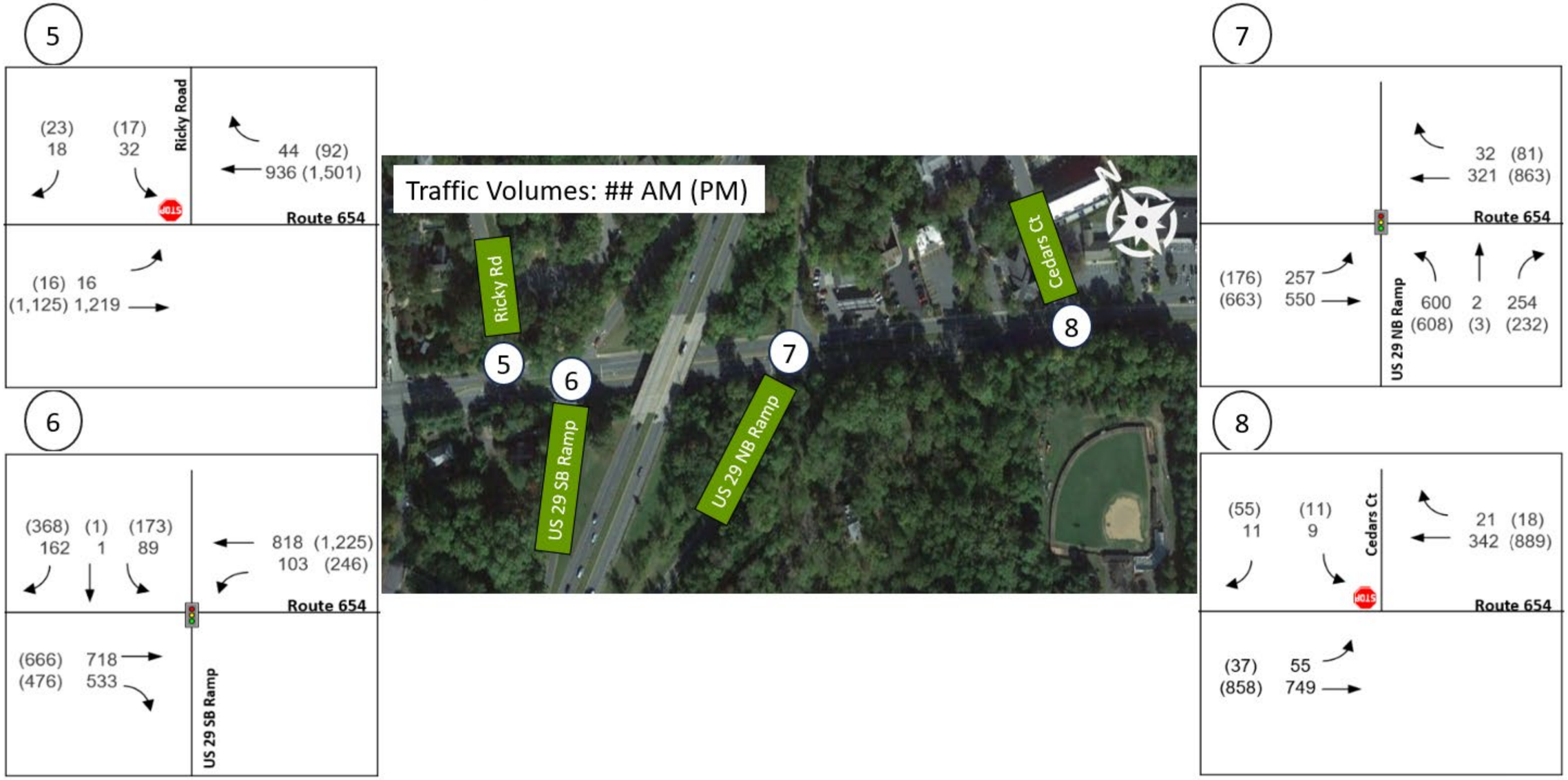
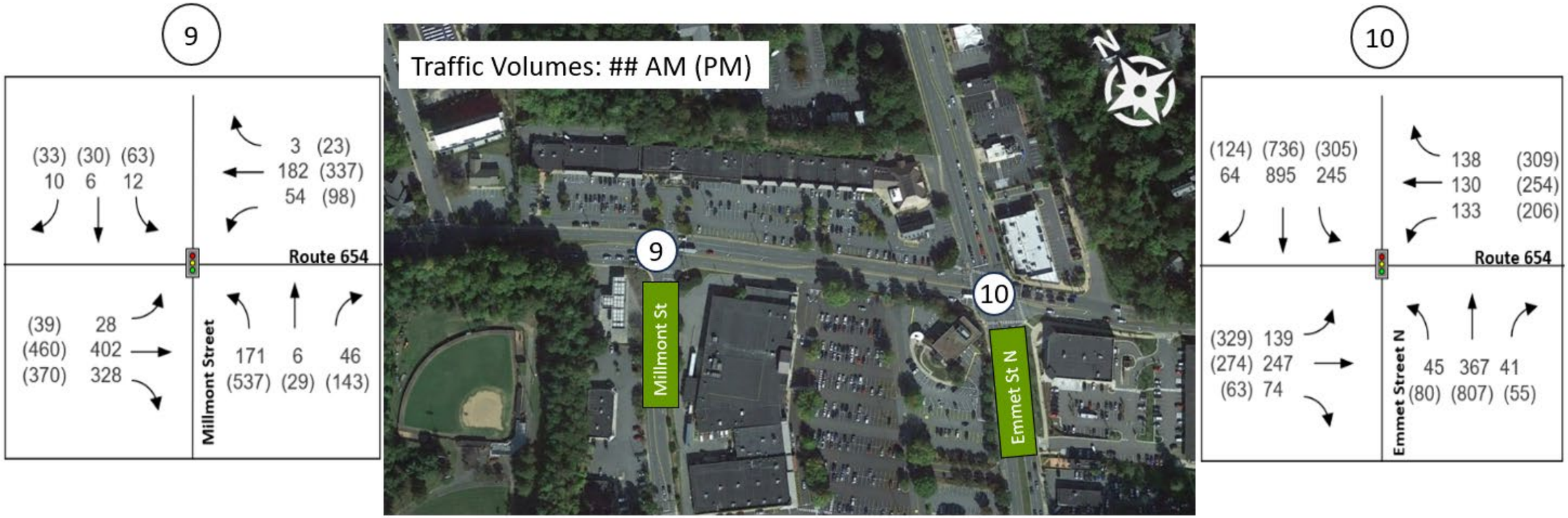


Figure 1-25. Barracks Road (Route 654) – 2045 Balanced Peak Hour Volumes (3 of 3)



2. Chapter 2 – Alternative Development and Refinement

A future years 2035 and 2045 No-Build analysis was performed for the study corridor in Synchro 11, utilizing the future volumes developed in **Section 1.8.** The No-Build model included background improvements specific to the study corridor and optimization of signalized intersections' cycle length, timing, and phasing. Additionally, VDOT's Junction Screening Tool (VJuST) was utilized to evaluate innovative intersection configurations at specific locations along the study corridor. The intent of using this tool was to identify innovative intersection configurations that have the potential for reducing congestion and improving safety. Congestion results are based on existing peak hour volumes, the number of lanes and lane configurations, while safety results are based on conflict points. Results from the tool are not meant to replicate results obtained from more detailed traffic operations, safety, and design analyses.

The findings from the existing and no-build conditions analyses and community feedback were utilized to develop build concepts for the study corridor. As the nature of the future build concepts is to address spot operational and safety concerns, it is assumed that capacity is not being added to the facilities. Therefore, the future no-build and build conditions have the same peak hour volumes, except that the volume may be redistributed in a build concept if necessary.

a. Future Year 2035 No-Build Operational Analysis

Synchro (Version 11) was utilized to evaluate the average intersection delay per vehicle and level of service (LOS). *SimTraffic* was utilized to perform queueing analysis to determine the maximum queue lengths. The results were based on an average of ten (10) simulation runs. **Appendix E** provides the *Synchro/SimTraffic* output reports. The Synchro/SimTraffic analysis results for the year 2035 No-Build conditions, presented in **Table 2-1, Table 2-2, Table 2-3, and Table 2-4**, indicate that:

- The Barracks Road intersection at Georgetown Road is expected to operate at an overall Level of Service (LOS) D during the AM and PM peak hours. However, the northbound approach is forecast to experience poor service, specifically LOS E during the AM peak hour and LOS F during the PM peak hour. These LOS ratings provide insights into traffic flow and congestion, with higher ratings indicating better performance. In this case, addressing congestion on the northbound approach may be necessary to improve traffic efficiency.
- The Barracks Road intersection at the junction of Chaucer Road is expected to maintain a Level of Service (LOS) of B or better for all movements during both the AM and PM peak hours. However, there's an exception: the southbound approach is forecast to a lower level of service, specifically LOS E during the AM peak hour and LOS F during the PM peak hour. Addressing congestion on the southbound approach is crucial to enhance traffic flow and efficiency.
- The Barracks Road intersection at Surrey Road is expected to maintain a Level of Service (LOS) of C or better for all movements during the AM and PM peak hours. However, there's an exception: the southbound approach is estimated at a lower level of service, specifically LOS F, during the AM and PM peak hours.
- The Barracks Road intersection at Bennington Road is anticipated to maintain a Level of Service (LOS) of C or better for all movements during the AM and PM peak hours. However, there's an exception: the southbound approach is projected to experience a poor level of service, specifically LOS F, during the AM and PM peak hours. Moreover, the northbound approach is forecast at a lower level of service, specifically LOS D, during the AM peak hour.
- The Barracks Road intersection at Ricky Road is expected to maintain a Level of Service (LOS) of A for all movements during the AM and PM peak hours. However, there's an exception: the southbound approach is estimated to experience a poor level of service, specifically LOS E during the AM peak hour and LOS F during the PM peak hour.
- The Barracks Road intersection at the US 29 SB Off Ramp is expected to operate at an overall Level of Service (LOS) B / C during the AM and PM peak hours, respectively. However, there are specific exceptions: The southbound approach is projected to experience a lower level of service, specifically LOS E, during both the AM and PM peak hours. The southbound right-turn movement is forecast to operate at an even lower level of service, specifically LOS F, during the PM peak hour.
- Overall, the Barracks Road at US 29 NB Off Ramp intersection is forecasted at LOS C / D during the AM / PM peak hours, respectively. During the PM peak, the eastbound left-turn movement is forecast to operate at LOS E. The northbound left-turn movement is predicted to operate at LOS E during the PM peak hour.
- Overall, the Barracks Road at Cedars Court intersection is anticipated to maintain a Level of Service (LOS) C or better for all movements during the AM and PM peak hours.
- Overall, the Barracks Road at Millmont Street intersection is expected to operate at a Level of Service (LOS) C / D during both the AM and PM peak hours, respectively. Additionally, several individual movements are forecast to experience level of service (LOS) D during the AM and PM peak hours.
- The Barracks Road at Emmet Street overall intersection is expected to operate at a Level of Service (LOS) C / D during both the AM and PM peak hours, respectively. Additionally, several individual movements are predicted to experience a lower level of service, specifically LOS E, during the PM peak hour.

Table 2-1. Barracks Road (Route 654) - 2035 No-Build Intersection Analysis Results (1 of 4)

Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		NB 2035 Queue Max (ft.)		Storage (ft.)
			AM	PM	AM	PM	AM	PM	
Barracks Rd at Georgetown Rd -Signalized-	EB	EBL	18.0	27.6	B	C	170	170	170
		EBR/T	29.2	28.1	C	C	465	412	
	WB	WBL	25.2	26.4	C	C	38	85	170
		WBT	33.1	43.7	C	D	364	568	
		WBR	33.1	43.0	C	D	241	327	
	NB	NBL/T	60.4	83.9	E	F	82	50	
		NBR	56.9	80.6	E	F	30	38	115
	SB	SBL	51.7	75.3	D	E	279	280	280
		SBL/R/T	51.7	75.3	D	E	446	627	
		OVERALL	**36.1**	**49.6**	D	D			
Barracks Rd at US 29 SB Off Ramp -Signalized-	EB	EBR	9.0	18.5	A	B	172	172	
		EBT	9.0	18.5	A	B	171	172	
	WB	WBL	26.5	33.2	C	C	141	164	165
		WBT	0.7	1.9	A	A	60	316	
	SB	SBL/T	55.6	64.6	E	E	140	268	
		SBR	51.7	81.8	D	F	129	368	
		OVERALL	**11.7**	**23.3**	B	C			
Barracks Rd at US 29 NB Off Ramp -Signalized-	EB	EBL	49.7	74.6	D	E	212	214	215
		EBT	36.9	31.0	D	C	306	368	
	WB	WBR/T	30.3	47.4	C	D	205	459	
	NB	NBL/T	35.0	65.6	C	E	847	1038	
		NBR	22.6	34.3	C	C	305	305	305
		OVERALL	**34.8**	**48.0**	C	D			

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.
*HCM 2000 Methodology

Table 2-2. Barracks Road (Route 654) - 2035 No-Build Intersection Analysis Results (2 of 4)

Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		NB 2035 Queue Max (ft.)		Storage (ft.)
			AM	PM	AM	PM	AM	PM	
Barracks Rd at Millmont St -Signalized-	EB	EBL	22.9	31.5	C	C	54	160	160
		EBR	25.7	36.2	C	D	160	160	160
		EBT	28.0	39.7	C	D	324	424	
	WB	WBL	36.6	49.2	D	D	110	171	235
		WBR/T	22.8	32.0	C	C	104	194	
		WBT	22.8	32.0	C	C	94	199	
	NB	NBL	34.3	45.8	C	D	136	340	380
		NBR/T	33.4	42.6	C	D	174	399	
	SB	SBL	21.9	37.0	C	D	33	90	
		SBR/T	22.0	37.0	C	D	41	90	
		OVERALL	**27.8**	**39.4**	C	D			
Barracks Rd at Emmet St N -Signalized-	EB	EBL	31.8	48.6	C	D	111	214	350
		EBR/T	44.0	72.1	D	E	385	462	
	WB	WBL	41.3	52.3	D	D	148	150	150
		WBR	40.0	51.0	D	D	109	225	200
		WBT	45.0	72.2	D	E	277	366	
	NB	NBL	48.9	67.2	D	E	89	240	240
		NBR	30.2	36.7	C	D	46	225	200
		NBT	33.9	52.3	C	D	219	388	
	SB	SBL	45.3	71.0	D	E	280	359	390
		SBR	0.0	0.1	A	A	154	176	220
		SBT	28.5	31.6	C	C	295	386	
		OVERALL	**34.9**	**50.7**	C	D			

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.
*HCM 2000 Methodology

Table 2-3. Barracks Road (Route 654) - 2035 No-Build Intersection Analysis Results (3 of 4)

Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		NB 2035 Queue Max (ft.)		Storage (ft.)
Barracks Rd at Chaucer Rd -Unsignalized-	EB	EBL	14.1	12.0	B	B	6	11	145
		EBR/T	0.0	0.0	A	A	2	0	
		EBT	0.0	0.0	A	A	1	0	
	WB	WBL	11.5	11.0	B	B	26	24	115
		WBR/T	0.2	0.1	A	A	0	0	
		WBT	0.2	0.1	A	A	0	0	
	NB	NBL/R/T	13.4	12.4	B	B	44	30	
	SB	SBL/R/T	45.4	97.8	E	F	48	46	150
Barracks Rd at Surrey Rd -Unsignalized-	EB	EBL	9.7	12.0	A	B	8	34	150
		EBR/T	0.0	0.0	A	A	0	3	
		EBT	0.0	0.0	A	A	0	3	
	WB	WBL	14.1	11.0	B	B	36	48	135
		WBR/T	0.1	0.1	A	A	3	12	
		WBT	0.1	0.1	A	A	3	12	
	NB	NBL/R/T	23.6	23.9	C	C	45	32	
	SB	SBL/R/T	64.9	97.5	F	F	58	42	
Barracks Rd at Bennington Rd -Unsignalized-	EB	EBL	9.9	12.5	A	B	11	42	130
		EBR/T	0.0	0.1	A	A	21	248	
		EBT	0.0	0.1	A	A	21	127	
	WB	WBL	14.2	13.3	B	B	39	61	105
		WBR/T	0.2	0.3	A	A	2	38	
		WBT	0.2	0.3	A	A	2	38	
	NB	NBL/R/T	25.2	18.4	D	C	39	55	
	SB	SBL/R/T	76.6	263.7	F	F	87	164	

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.
*HCM 6th Ed Methodology

Table 2-4. Barracks Road (Route 654) - 2035 No-Build Intersection Analysis Results (4 of 4)

Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		NB 2035 Queue Max (ft.)		Storage (ft.)
Barracks Rd at Ricky Rd -Unsignalized-	EB	EBL	10.2	14.5	B	B	45	53	60
		EBT	0.1	0.2	A	A	129	269	
	WB	WBR/T	0.0	0.0	A	A	17	36	
		WBT	0.0	0.0	A	A	11	20	
	SB	SBL/R	47.6	69.8	E	F	329	488	
Barracks Rd at Cedars Ct -Unsignalized-	EB	EBL	8.4	11.4	A	B	44	62	110
		EBT	0.6	0.5	A	A	0	85	
	WB	WBR/T	0.0	0.1	A	A	2	25	
		WBT	0.0	0.1	A	A	2	25	
	SB	SBL/R	13.1	18.4	B	C	42	68	

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.
*HCM 6th Ed Methodology

b. Future Year 2045 No-Build Operational Analysis

Synchro (Version 11) was utilized to evaluate the average intersection delay per vehicle and level of service (LOS). *SimTraffic* was utilized to perform queueing analysis to determine the maximum queue lengths. The results were based on an average of ten (10) simulation runs. **Appendix E** provides the *Synchro/SimTraffic* output reports. The Synchro/SimTraffic analysis results for the year 2045 No-Build conditions, presented in **Table 2-5, Table 2-6, Table 2-7,** and **Table 2-8**, indicate that:

- Overall, the Barracks Road at Georgetown Road intersection is forecast to operate at Level of Service (LOS) D during the AM and PM peak hours. The northbound approach is expected to operate at LOS E and LOS F during the AM and PM peak hours, respectively. The southbound approach is anticipated to operate at LOS D and LOS F during the AM and PM peak hours, respectively.
- The Barracks Road at Chaucer Road intersection is anticipated to maintain a Level of Service (LOS) C or better for all movements during the AM and PM peak hours. The exception is the southbound approach, which is forecast to operate at (LOS) F during the AM and PM peak hours.
- The Barracks Road and Surrey Road intersection is forecast to operate at LOS C or better for all movements during the AM and PM peak hours. Except for the southbound approach, it is predicted to operate at Level of Service (LOS) F during the AM and PM peak hours. In addition,

the northbound approach is also forecast to operate at Level of Service (LOS) D during the AM and PM peak hours.

- The Barracks Road and Bennington Road intersection is projected to operate at LOS C or better for all movements during the AM and PM peak hours. Except for the southbound approach, it is estimated to operate at a level of service (LOS) F during the AM and PM peak hours. In addition, the northbound approach is forecast to operate at Level of Service (LOS) D during the AM peak hour.
- The Barracks Road and Ricky Road intersection is expected to operate at LOS C or better for all movements during the AM and PM peak hours. Except for the southbound approach, which is anticipated to operate at (LOS) F during the AM and PM peak hours,
- Overall, the Barracks Road and US 29 SB Off Ramp intersection is forecasted to operate at LOS B / C during the AM / PM peak hours, respectively. The southbound right-turn is projected to operate at LOS E and LOS F during the AM and PM peak hours, respectively. The southbound left-turn movement is estimated to operate at LOS E during the AM and PM peak hours.
- Overall, the Barracks Road and US 29 NB Off Ramp intersection is forecast to operate at LOS D / E during the AM / PM peak hours, respectively. The eastbound left-turn movement is estimated to operate at LOS E and LOS F during the AM and PM peak hours, respectively. The northbound left-turn movement is projected to operate at LOS D and LOS E during the AM and PM peak hours, respectively.
- The Barracks Road and Cedars Court intersection is anticipated to operate at LOS C or better for all movements during the AM and PM peak hours.
- Overall, the Barracks Road and Millmont Street intersection is forecasted to operate at LOS C / D during the AM / PM peak hours, respectively. Several individual movements are predicted to operate at LOS D during the PM peak hour.
- The Barracks Road and Emmet Street intersection is expected to operate, overall, at level of service (LOS) D during the AM and PM peak hours. Several individual movements are estimated to operate at LOS E during the PM peak hour.

Table 2-5. Barracks Road (Route 654) - 2045 No-Build Intersection Analysis Results (1 of 4)

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		NB 2045 Queue Max (ft.)		Storage (ft.)
1	Barracks Rd at Georgetown Rd -Signalized-	EB	EBL	19.0	33.9	B	C	170	170	170
			EBR/T	35.6	30.7	D	C	583	482	
		WB	WBL	26.6	27.6	C	C	83	85	170
			WBT	34.5	49.7	C	D	392	587	
			WBR	29.8	49.4	C	D	235	392	
		NB	NBL/T	62.8	88.8	E	F	62	55	
			NBR	59.2	85.4	E	F	38	38	115
		SB	SBL	53.1	81.2	D	F	280	280	280
			SBL/R/T	51.6	76.8	D	E	460	632	
			OVERALL	**38.0**	**54.8**	D	D			
2	Barracks Rd at US 29 SB Off Ramp -Signalized-	EB	EBR	10.1	26.4	B	C	172	172	
			EBT	10.1	26.4	B	C	172	172	
		WB	WBL	30.3	15.1	C	B	148	164	165
			WBT	0.7	3.0	A	A	66	286	
		SB	SBL/T	59.4	64.3	E	E	192	375	
			SBR	55.1	106.6	E	F	151	642	
			OVERALL	**12.6**	**28.0**	B	C			
3	Barracks Rd at US 29 NB Off Ramp -Signalized-	EB	EBL	56.9	84.9	E	F	214	214	215
			EBT	38.3	37.2	D	D	392	379	
		WB	WBR/T	32.8	59.0	C	E	191	526	
		NB	NBL/T	41.1	68.0	D	E	926	1,057	
			NBR	23.8	32.8	C	C	305	305	305
			OVERALL	**38.7**	**55.1**	D	E			

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*HCM 2000 Methodology

Table 2-6. Barracks Road (Route 654) - 2045 No-Build Intersection Analysis Results (2 of 4)

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		NB 2045 Queue Max (ft.)		Storage (ft.)
				AM	PM	AM	PM	AM	PM	
4	Barracks Rd at Millmont St -Signalized-	EB	EBL	22.2	31.2	C	C	118	160	160
			EBR	26.2	37.9	C	D	160	160	160
			EBT	29.0	41.8	C	D	389	434	
		WB	WBL	36.8	51.7	D	D	106	181	235
			WBR/T	24.3	34.3	C	C	105	217	
			WBT	24.3	34.3	C	C	113	203	
		NB	NBL	34.6	45.9	C	D	139	367	380
			NBR/T	33.3	44.0	C	D	170	475	
		SB	SBL	22.1	38.7	C	D	44	90	
			SBR/T	22.1	38.8	C	D	53	90	
			OVERALL	**28.5**	**41.0**	C	D			
5	Barracks Rd at Emmet St N -Signalized-	EB	EBL	33.1	47.4	C	D	104	220	350
			EBR/T	45.8	73.0	D	E	378	540	
		WB	WBL	44.4	64.0	D	E	148	366	150
			WBR	42.9	53.7	D	D	114	304	200
			WBT	49.1	60.5	D	E	213	304	
		NB	NBL	52.9	68.0	D	E	95	210	240
			NBR	32.4	52.9	C	D	60	485	200
			NBT	36.6	52.9	D	D	190	240	
		SB	SBL	47.8	76.0	D	E	336	442	390
			SBR	0.1	0.1	A	A	198	451	220
			SBT	30.3	31.7	C	C	417	225	
			OVERALL	**37.1**	**51.4**	D	D			

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*HCM 2000 Methodology

Table 2-7. Barracks Road (Route 654) - 2045 No-Build Intersection Analysis Results (3 of 4)

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		NB 2045 Queue Max (ft.)		Storage (ft.)
				AM	PM	AM	PM	AM	PM	
6	Barracks Rd at Chaucer Rd -Unsignalized-	EB	EBL	15.3	12.7	C	B	4	9	145
			EBR/T	0.0	0.0	A	A	3	26	
			EBT	0.0	0.0	A	A	2	26	
		WB	WBL	12.2	11.6	B	B	47	97	115
			WBR/T	0.2	0.1	A	A	0	38	
			WBT	0.2	0.1	A	A	0	23	
		NB	NBL/R/T	14.3	13.0	B	B	45	69	
		SB	SBL/R/T	58.6	143.1	F	F	65	0	150
7	Barracks Rd at Surrey Rd -Unsignalized-	EB	EBL	10.1	15.1	B	C	13	45	150
			EBR/T	0.0	0.1	A	A	2	0	
			EBT	0.0	0.1	A	A	2	0	
		WB	WBL	15.5	15.1	C	C	34	45	135
			WBR/T	0.1	0.2	A	A	2	11	
			WBT	0.1	0.2	A	A	2	5	
		NB	NBL/R/T	30.0	28.6	D	D	48	36	
		SB	SBL/R/T	96.0	151.6	F	F	74	68	
8	Barracks Rd at Bennington Rd -Unsignalized-	EB	EBL	10.2	13.3	B	B	6	31	130
			EBR/T	0.0	0.1	A	A	77	235	
			EBT	0.0	0.1	A	A	5	124	
		WB	WBL	15.6	14.4	C	B	47	67	105
			WBR/T	0.2	0.4	A	A	4	32	
			WBT	0.2	0.4	A	A	5	12	
		NB	NBL/R/T	32.5	21.2	D	C	35	62	
		SB	SBL/R/T	106.5	429.7	F	F	107	329	

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*HCM 6th Ed Methodology

Table 2-8. Barracks Road (Route 654) - 2045 No-Build Intersection Analysis Results (4 of 4)

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		NB 2045 Queue Max (ft.)		Storage (ft.)
				AM	PM	AM	PM	AM	PM	
9	Barracks Rd at Ricky Rd -Unsignalized-	EB	EBL	10.6	15.8	B	C	38	58	60
			EBT	0.1	0.2	A	A	249	271	
		WB	WBR/T	0.0	0.0	A	A	17	38	
			WBT	0.0	0.0	A	A	18	29	
		SB	SBL/R	65.2	106.0	F	F	474	648	
10	Barracks Rd at Cedars Ct -Unsignalized-	EB	EBL	8.5	11.8	A	B	49	58	110
			EBT	0.6	0.5	A	A	41	182	
		WB	WBR/T	0.0	0.1	A	A	0	62	
			WBT	0.0	0.1	A	A	0	62	
		SB	SBL/R	14.1	20.3	B	C	46	103	
Delay values highlighted in Green, Yellow, Orange and Red indicated LOS A-C, D, E and F respectively.										
*HCM 6th Ed Methodology										

c. Future Year 2035 Build Operational Analysis

Synchro (Version 11) was utilized to evaluate the average intersection delay per vehicle and level of service (LOS). *SimTraffic* was utilized to perform queueing analysis to determine the maximum queue lengths. The results were based on an average of ten (10) simulation runs. **Appendix E** provides the *Synchro/SimTraffic* output reports. The Synchro/SimTraffic analysis results for the year 2035 build conditions, presented in **Table 2-9, Table 2-10, Table 2-11,** and **Table 2-12,** indicate that:

Concept 1: The analysis results, presented in **Table 2-9**, can be summarized as follows:

- The original Barrack Road roundabout at Georgetown Road is expected to perform at a Level of Service (LOS) A / B during the AM / PM peak hours, respectively. This indicates a relatively smooth flow of traffic with minor delays. However, specific movements within the roundabout exhibit different performance levels, and the analysis results are presented in. During the PM peak hour, there are moderate delays and queue lengths for vehicles turning left on the southbound approach. Overall, the roundabout's performance is satisfactory, but specific individual movements may experience slightly higher congestion.
- The Barracks Road at Georgetown Road roundabout with southbound revisions (exclusive left and left/through/right approach lanes) is forecast to operate at Level of Service (LOS) A / B during the AM / PM peak hours, respectively. All individual movements are estimated to operate at LOS B or better during the AM and PM peak hours. Overall, the roundabout's performance is satisfactory. The southbound approach delays and queue lengths are lower in this revised roundabout scenario than in the original roundabout design. The analysis results are presented in**.**

Concept 2: Pedestrian improvements can be summarized as follows:

- Pedestrian improvement (10-foot Shared Use Path) is proposed for the south side of Barracks Road from Georgetown Road to Surrey Road. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Concept 3: Pedestrian improvements can be summarized as follows:

- Pedestrian improvement (10-foot Shared Use Path) is proposed for the south side of Barracks Road from Surrey Road to the Bypass. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Concept 4: The analysis results, presented in **Table 2-10**, can be summarized as follows:

- The Barracks Road intersection with the US 29 SB Off Ramp dedicated eastbound right turn, the overall Level of Service (LOS) during the AM and PM peak hours is expected to be A/C, respectively. This indicates a relatively smooth traffic flow with minor delays. However, the southbound right turn movements are forecast to operate at LOS D during the AM peak hour and LOS E during the PM peak hour. Southbound left turn movements in the southbound direction are anticipated to operate at LOS D during the AM and PM peak hours. In summary, while the overall intersection performance is satisfactory, specific individual movements may experience congestion, particularly southbound right turns.

Concept 5: The analysis results, presented in **Table 2-11**, can be summarized as follows:

- The Barracks Road at US 29 SB Off Ramp roundabout, the overall Level of Service (LOS) during the AM and PM peak hours is expected to be LOS A. This indicates smooth traffic flow with minimal delays. The southbound through movement is projected to operate at LOS E during the AM peak hour. Other individual movements within the roundabout are expected to perform even better, operating at LOS B or better during peak hours. In summary, the overall performance of this roundabout is sufficient, with most movements experiencing efficient traffic flow.

- The roundabout at the Barracks Road at US 29 NB Off Ramp is expected to operate at LOS A/B during the AM and PM peak hours, respectively. This indicates a relatively smooth traffic flow with minor delays. In summary, the overall performance of this roundabout is adequate, with most movements experiencing efficient traffic flow.

Concept 6: The analysis results, presented in **Table 2-12**, can be summarized as follows:

- The Barracks Road at US 29 NB Off Ramp intersection dual lefts is forecast to operate, overall, at LOS C/ D during the AM / PM peak hours, respectively. The eastbound left-turn movement is estimated to operate at LOS E and LOS F during the AM and PM peak hours, respectively. The northbound left-turn movement is projected to operate at LOS C and LOS D during the AM and PM peak hours, respectively.

Concept 7: Pedestrian improvements can be summarized as follows:

- Pedestrian improvement (10-foot Shared Use Path) is proposed for the south side of Barracks Road from the Bypass to Emmet Street. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Concept 8: The analysis results, presented in **Table 2-13**, can be summarized as follows:

- The Barracks Road at US 29 NB Off Ramp Diverge segment is forecast to operate at LOS B during the AM and PM peak hours. In summary, the overall deceleration lane performance is satisfactory. The build conditions off-ramp is proposed to be extended to standard design length, which results in slightly lower density values than the No Build conditions.

Table 2-9. Barracks Road (Route 654) - 2035 Build Roundabouts Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		SIDRA 95th Percentile (ft.)	
				AM	PM	AM	PM	AM	PM
1	Barracks Rd at Georgetown Rd-Original -Roundabout-	EB	EBL	13.9	14.4	B	B	106.3	93.9
			EBT	12.2	12.7	B	B	114.3	101.9
			EBR	11.3	11.5	B	B	114.3	101.9
		WB	WBU	7.2	8.6	A	A	86.2	139.4
			WBL	7	8.4	A	A	86.2	139.4
			WBT	7.4	8.5	A	A	86.2	139.4
			WBR	6.5	10	A	A	79.9	158.8
		NB	NBL	8.8	8.3	A	A	7.2	5.7
			NBT	12.7	14.9	B	B	7.2	5.7
			NBR	8.8	8.3	A	A	7.2	5.7
		SB	SBL	11.1	22.3	B	C	165.0	346.0
			SBT	10.6	26.0	B	C	165.0	346.0
			SBR	6.7	11.1	A	B	17.8	50.8
			OVERALL	9.6	13.1	A	B		
2	Barracks Rd at Georgetown Rd - SB Revised -Roundabout-	EB	EBL	11.1	10.7	B	B	68	53.9
			EBT	10.4	10.2	B	B	69.1	54.9
			EBR	10	9.5	A	A	69.1	54.9
		WB	WBU	7.3	8.8	A	A	81.3	132.6
			WBL	7.1	8.6	A	A	81.3	132.6
			WBT	7.5	8.7	A	A	81.3	132.6
			WBR	6.6	10.4	A	B	77.3	154
		NB	NBL	7.4	7.1	A	A	6.8	4.8
			NBT	10.9	13.3	B	B	6.8	4.8
			NBR	7.4	7.1	A	A	6.8	4.8
		SB	SBL	7.8	13.8	A	B	67	148.4
			SBT	6.8	15.7	A	B	67	148.4
			SBR	7.2	12.3	A	B	67	148.4
			OVERALL	8.3	10.9	A	B		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*SIDRA HCS Methodology

Table 2-10. Barracks Road (Route 654) - 2035 Build Eastbound Right Turn Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		BD 2035 Queue Max (ft.)	
				AM	PM	AM	PM	AM	PM
3	Barracks Rd at 29 SB Off Ramp -Signalized-	EB	**EBR**	7.7	26.7	A	C	166	172
			EBT	7.7	26.7	A	C	168	169
		WB	WBL	9.1	8.2	A	A	92	154
			WBT	0.8	1.9	A	A	78	244
		SB	SBL/T	50.0	54.4	D	D	146	247
			SBR	46.8	67.0	D	E	120	344
			OVERALL	**9.8**	**21.7**	A	C		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*HCM 2000 Methodology

95th percentile volume exceeds capacity; queue may be longer.

Table 2-11. Barracks Road (Route 654) - 2035 Build Roundabouts Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		SIDRA 95th Percentile (ft.)	
				AM	PM	AM	PM	AM	PM
4	Barracks Rd at US 29 SB Off Ramp -Roundabout-	EB	EBU	8.6	10.3	A	B	116.8	150.1
			EBT	8.6	10.3	A	B	116.8	150.1
			EBR	8.1	9.9	A	A	86.9	150.1
		WB	WBU	5	6.7	A	A	59.7	117.2
			WBL	5.0	6.7	A	A	59.7	117.2
			WBT	4.8	6.5	A	A	60.5	118.9
		NB	SBL	6.9	12.3	A	B	13.4	37.9
			SBT	62.2	11.8	E	B	13.4	37.9
			SBR	6.7	12.2	A	B	20.5	70.3
			OVERALL	6.9	8.8	A	A		
5	Barracks Rd at US 29 NB Off Ramp -Roundabout-	EB	EBU	5.8	6.2	A	A	202.7	243.4
			EBL	5.9	6.2	A	A	202.7	243.4
			EBT	5.9	6.1	A	A	202.7	243.4
		WB	WBU	10.4	25.0	B	C	53.1	232.2
			WBT	10.2	22.0	B	C	59.1	257.8
			WBR	9.20	20.8	A	C	59.1	257.8
		NB	NBL	14.1	16.1	B	B	199.5	233.0
			NBT	13.5	15.5	B	B	199.5	233.0
			NBR	10.9	1.8	B	A	70.1	32.7
			OVERALL	9.7	14.6	A	B		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*SIDRA HCS Methodology *(+) Computation Not Defined

Table 2-12. Barracks Road (Route 654) - 2035 Build Northbound Dual Lefts Turn Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		BD 2035 Queue Max (ft.)	
				AM	PM	AM	PM	AM	PM
6	Barracks Rd at 29 NB Off Ramp -Signalized-	EB	EBL	55.9	82.3	E	F	214	214
			EBT	41.4	31.1	D	C	346	369
		WB	WBR/T	32.8	38.0	C	D	178	468
		NB	NBL	20.1	46.8	C	D	238	339
			NBR	17.9	38.8	B	D	142	247
			OVERALL	**32.2**	**41.4**	C	D		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*HCM 2000 Methodology

95th percentile volume exceeds capacity; queue may be longer.

Table 2-13. Northbound Off-Ramp - 2035 Build US 29 NB Ramp HCS Analysis Results

		NB 2035		BD 2035	
		AM	PM	AM	PM
US 29 NB Off Ramp Diverge segment	Density (D), pc/mi/ln	15.6	19.0	13.7	17.1
	Level of Service (LOS)	**B**	**B**	**B**	**B**

d. Future Year 2045 Build Operational Analysis

Synchro (Version 11) was utilized to evaluate the average intersection delay per vehicle and level of service (LOS). *SimTraffic* was utilized to perform queueing analysis to determine the maximum queue lengths. The results were based on an average of ten (10) simulation runs. **Appendix E** provides the *Synchro/SimTraffic* output reports. The Synchro/SimTraffic analysis results for the year 2045 build conditions, presented in **Table 2-14, Table 2-15, Table 2-16,** and **Table 2-17,** indicate that:

Concept 1: The analysis results, presented in, can be summarized as follows:

- The original Barrack Road roundabout at Georgetown Road is expected to perform at a Level of Service (LOS) of B during the AM and PM peak hours. This indicates a relatively smooth flow of traffic with minor delays. However, there are specific movements within the roundabout that exhibit poor performance levels, the analysis results are presented in **Table 2-14**.
  The southbound left and through movements are anticipated to operate at LOS D during the PM peak hour, with queues approaching 600 feet. This suggests moderate delays for vehicles turning left. Southbound through movements are also forecast to operate at LOS D during the PM peak hour. Overall, the roundabout's performance is satisfactory, but specific individual movements may experience slightly more congestion.
- The Barracks Road at Georgetown Road roundabout with southbound revisions (exclusive left and left/through/right approach lanes) are estimated to operate, overall, at Level of Service (LOS) A / B during the AM / PM peak hours, respectively. All individual movements are projected to operate at LOS B or better during the AM and PM peak hours. The southbound queues are reduced to just under 200 feet in the PM peak hour, which is a significant reduction from the original roundabout design. The analysis results are presented in **Table 2-14.**

Concept 2: Pedestrian improvements can be summarized as follows:

- Pedestrian improvement (10-foot Shared Use Path) is proposed for the south side of Barracks Road from Georgetown Road to Surrey Road. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Concept 3: Pedestrian improvements can be summarized as follows:

- Pedestrian improvement (10-foot Shared Use Path) is proposed for the south side of Barracks Road from Surrey Road to the Bypass. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Concept 4: The analysis results, presented in **Table 2-15**, can be summarized as follows:

- The Barracks Road intersection with the US 29 SB Off Ramp dedicated eastbound right turn, the overall Level of Service (LOS) during the AM and PM peak hours is expected to be B/C, respectively. This indicates a relatively smooth traffic flow with minor delays. However, specific movements within this intersection, such as southbound right turn movements, are forecast to operate at LOS E during the AM peak hour and LOS F during the PM peak hour. This suggests moderate to significant delays for vehicles making right turns. Southbound left turn movements in the southbound direction are anticipated to operate at LOS E during the AM and PM peak hours. In summary, while the overall intersection performance is satisfactory, certain individual movements may experience congestion, particularly the southbound movements.

Concept 5: The analysis results, presented in **Table 2-16**, can be summarized as follows:

- The Barracks Road at US 29 SB Off Ramp roundabout, the overall Level of Service (LOS) during the AM and PM peak hours is expected to be LOS A. This indicates smooth traffic flow with minimal delays. The very low volume southbound through movement is projected to operate at LOS E during the AM peak hour. All other movements within the roundabout are anticipated to perform at LOS B or better during peak hours. In summary, the overall performance of this roundabout is sufficient, with most movements experiencing efficient traffic flow.
- The roundabout at the Barracks Road and US 29 NB Off Ramp is expected to operate at LOS B/C during the AM and PM peak hours, respectively. This indicates a relatively smooth traffic flow with minor delays. However, the westbound approach is forecast to experience a poor Level of Service (LOS) D, specifically during the PM peak hour. In summary, the overall performance of this roundabout is sufficient, with most movements experiencing efficient traffic flow.

Concept 6: The analysis results, presented in **Table 2-17**, can be summarized as follows:

- The Barracks Road at US 29 NB Off Ramp intersection dual lefts is forecast to operate, overall, at LOS C/ D during the AM / PM peak hours, respectively. The eastbound left-turn movement is expected to operate at LOS E and LOS F during the AM and PM peak hours, respectively. The northbound left-turn movement is projected to operate at LOS C and LOS D during the AM and PM peak hours, respectively. Additionally, the westbound approach is predicted to experience a poor Level of Service (LOS) of E, specifically during the PM peak hour.

Concept 7: Pedestrian improvements can be summarized as follows:

- Pedestrian improvement (10 feet Shared Use Path) is proposed for the south side of Barracks Road from Bypass to Emmet Street. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Concept 8: The analysis results, presented in **Table 2-18**, can be summarized as follows:

- The Barracks Road at US 29 NB Off Ramp Diverge segment is forecast to operate with LOS C and D conditions in the AM and PM peak hours, respectively. In summary, the overall deceleration lane performance is satisfactory; the build conditions show an improvement over the No Build scenario (shown in **),** which has Level of Service (LOS) E during the PM peak hour.

Table 2-14. Barracks Road (Route 654) - 2045 Build Roundabouts Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		SIDRA 95th Percentile (ft.)	
				AM	PM	AM	PM	AM	PM
1	Barracks Rd at Georgetown Rd - Original -Roundabout-	EB	EBL	17	18.1	B	B	149.5	122.6
			EBT	14.9	15.9	B	B	163.0	135.8
			EBR	13.9	14.4	B	B	163.0	135.8
		WB	WBU	7.8	9.6	A	A	100.7	167.0
			WBL	7.6	9.4	A	A	100.7	167.0
			WBT	8	9.5	A	A	100.7	167.0
			WBR	6.8	10.9	A	B	87.3	167.0
		NB	NBL	10.1	9.1	B	A	9.0	6.6
			NBT	14.6	16.6	B	B	9.0	6.6
			NBR	10.1	9.1	B	A	9.0	6.6
		SB	SBL	12.2	39.8	B	D	183.5	581.9
			SBT	11.7	44.0	B	D	183.5	581.9
			SBR	7.1	12.8	A	B	18.7	58.9
			OVERALL	11.0	18.3	B	B		
2	Barracks Rd at Georgetown Rd - SB Revised -Roundabout-	EB	EBL	13.1	12.5	B	B	94	68.5
			EBT	12.3	11.9	B	B	96.8	70.5
			EBR	11.8	11	B	B	96.8	70.5
		WB	WBU	7.7	9.4	A	A	95.7	157.2
			WBL	7.5	9.2	A	A	95.7	157.2
			WBT	7.9	9.3	A	A	95.7	157.2
			WBR	6.7	10.7	A	B	82.7	170.9
		NB	NBL	7.9	7.6	A	A	6.3	4.9
			NBT	11.8	14.4	B	B	6.3	4.9
			NBR	7.9	7.6	A	A	6.3	4.9
		SB	SBL	8.4	17.7	A	B	71.8	197.4
			SBT	7.3	19.6	A	B	71.8	197.4
			SBR	7.7	15.8	A	B	71.8	197.4
			OVERALL	9.2	12.3	A	B		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*SIDRA HCS Methodology

Table 2-15. Barracks Road (Route 654) - 2045 Build Eastbound Right Turn Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		BD 2045 Queue Max (ft.)	
				AM	PM	AM	PM	AM	PM
3	Barracks Rd at US 29 SB Off Ramp EBR -Signalized-	EB	EBR	7.6	21.5	A	C	167	170
			EBT	7.6	21.5	A	C	160	169
		WB	WBL	10.1	14.7	B	B	136	158
			WBT	0.7	3.1	A	A	57	244
		SB	SBL/T	59.3	63.0	E	E	161	280
			SBR	55.0	106.6	E	F	132	512
			OVERALL	10.6	26.1	B	C		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*HCM 2000 Methodology

Table 2-16. Barracks Road (Route 654) - 2045 Build Roundabouts Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		SIDRA 95th Percentile (ft.)	
				AM	PM	AM	PM	AM	PM
4	Barracks Rd at US 29 SB Off Ramp -Roundabout-	EB	EBU	9.9	11.4	A	B	140.2	191.3
			EBT	9.9	11.4	A	B	140.2	191.3
			EBR	9.1	11.0	A	B	102.5	125.6
		WB	WBU	5.3	7.0	A	A	69.0	128.7
			WBL	5.3	7.0	A	A	69.0	128.7
			WBT	5.2	6.8	A	A	70.0	130.5
		NB	SBL	7.4	13.5	A	B	14.9	41.5
			SBT	69.9	13.0	E	B	14.9	41.5
			SBR	7.2	14.1	A	B	23.2	87.0
			OVERALL	7.7	9.7	A	A		
5	Barracks Rd at US 29 NB Off Ramp -Roundabout-	EB	EBU	6.1	6.6	A	A	258.9	328.2
			EBL	6.2	6.6	A	A	258.9	328.2
			EBT	6.2	6.5	A	A	258.9	328.2
		WB	WBU	13.3	43.7	B	D	69.4	370.1
			WBT	13.0	39.3	B	D	76.6	424.0
			WBR	11.70	36.8	B	D	76.6	424.0
		NB	NBL	19.7	25.0	B	C	297.4	369.7
			NBT	19.0	24.3	B	C	297.4	369.7
			NBR	12.4	12.6	B	B	82.1	77.0
			OVERALL	12.2	23.0	B	C		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.

*SIDRA HCS Methodology

Table 2-17. Barracks Road (Route 654) - 2045 Build Northbound Dual Lefts Turn Analysis Results

Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		BD 2045 Queue Max (ft.)	
EB	EBL	59.1	92.0	E	F	215	219
	EBT	39.7	42.4	D	D	349	425
WB	WBR/T	31.0	56.5	C	E	184	551
NB	**NBL**	26.8	37.5	C	D	284	385
	NBR	23.4	33.1	C	C	209	251
	OVERALL	**34.7**	**49.1**	C	D		

Delay values highlighted in Green, Yellow, Orange, and Red indicated LOS A-C, D, E, and F, respectively.
*HCM 2000 Methodology

Table 2-18. Northbound Off-Ramp - 2045 Build US 29 NB Ramp HCS Analysis Results

		NB 2045		BD 2045	
		AM	PM	AM	PM
US 29 NB Off Ramp Diverge segment	Density (D), pc/mi/ln	26.5	35.9	24.5	33.9
	Level of Service (LOS)	C	E	C	D

e.

VJuST Screening

Given the operational and safety needs of the study corridor, multiple innovative designs were screened using the VJuST screening tool. The results presented in **Table 2-19** through **Table 2-24**, indicate that:

- The Barracks Road at Georgetown Road intersection is expected to operate slightly better as a Partial Median U-Turn than a conventional roadway. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) when compared to a conventional intersection. The results are presented in **Table 2-19.**
- The Barracks Road at Chaucer Road intersection is expected to operate with improved safety with a Restricted Crossing U-Turn configuration. The restricted Crossing U-Turn configuration offers a lower total number of weighted conflict points (20 vs. 48) when compared to un-signalized intersection. The results are presented in **Table 2-20.**
- The Barracks Road at Surrey Road intersection is expected to operate with improved safety with a Restricted Crossing U-Turn configuration. The restricted Crossing U-Turn configuration offers a lower total number of weighted conflict points (20 vs. 48) when compared to un-signalized intersection. The results are presented in **Table 2-21.**
- The Barracks Road at Cedars Court intersection is expected to operate with improved safety with a Restricted Crossing U-Turn configuration. The restricted Crossing U-Turn configuration offers a lower total number of weighted conflict points (20 vs. 48) when compared to un-signalized intersection. The results are presented in **Table 2-22**.
- The Barracks Road at Millmont Street intersection is expected to operate slightly better as a Thru-Cut than a conventional roadway. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) when compared to a conventional intersection. The results are presented in **Table 2-23**.
- The Barracks Road and Emmet Street intersection is expected to operate much better as a Partial Median U-Turn than as a conventional roadway. The Partial Median U-Turn configuration offers a lower total number of weighted conflict points (28 vs. 48) when compared to a conventional intersection. The results are presented in **Table 2-24**.

Table 2-19. Barracks Road (Route 654) at Georgetown Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighte Total Conflic Points
AM	Conventional	-	0.53		48
	Partial Median U-Turn	-	0.38	+	28
	Thru-Cut	-	0.47		28
	Roundabout	-	0.74		8
PM	Conventional	-	0.70		48
	Partial Median U-Turn	-	0.31	+	28
	Thru-Cut	-	0.58		28
	Roundabout	-	0.94		8

Table 2-20. Barracks Road (Route 654) at Chaucer Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighte Total Conflic Points
AM	Restricted Crossing U-Turn	-	0.27		20
	Two-Way Stop Control	-	0.27		48
PM	Restricted Crossing U-Turn	-	0.32		20
	Two-Way Stop Control	-	0.31		48

Table 2-21. Barracks Road (Route 654) at Surrey Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighte Total Conflic Points
AM	Restricted Crossing U-Turn	-	0.27		20
	Two-Way Stop Control	-	0.27		48
PM	Restricted Crossing U-Turn	-	0.33		20
	Two-Way Stop Control	-	0.32		48

Table 2-22. Barracks Road (Route 654) at Cedars Ct VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weight Tota Confli Point
AM	Restricted Crossing U-Turn	-	0.20		20
	Two-Way Stop Control	-	0.19		48
PM	Restricted Crossing U-Turn	-	0.23		20
	Two-Way Stop Control	-	0.22		48

Table 2-23. Barracks Road (Route 654) at Millmont Street VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighte Total Conf Points
AM	Conventional	-	0.30		48
	Thru-Cut	-	0.25		28
	Roundabout	-	0.31		8
PM	Conventional	-	0.49		48
	Thru-Cut	-	0.36		28
	Roundabout	-	0.62		8

Table 2-24. Barracks Road (Route 654) at Emmet Street VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	We Total P
AM	Conventional	-	0.60		
	Partial Median U-Turn	-	0.30	+	
PM	Conventional	-	0.84		
	Partial Median U-Turn	-	0.41	+	

f. Build Concepts & Cost Estimate

The build concepts contain a variety of proposed intersection improvements for many of the study area intersections. Intersection improvements include roundabouts, access management, pedestrian accommodations, and interchange modifications.

The following concepts were evaluated as future build alternatives:

- **Concept 1** - The Georgetown Road intersection is proposed to be reconfigured as a hybrid roundabout. A raised median is proposed on Barracks Road from Georgetown Road to the southbound Bypass off-ramp intersection. A 10-foot shared use path is proposed on the south side of Barracks Road from Georgetown Road to the Bypass. The layout for Concept 1 is presented in **Figure 2-1**.
- **Concept 2** – Pedestrian improvements (sidewalks) are proposed for the south side of Barracks Road from Georgetown Road to Surrey Road. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed. The layout for Concept 2 is presented in **Figure 2-2**.
- **Concept 3** – Pedestrian improvements (sidewalks) are proposed for Barracks Road's south side from Surrey Road to the Bypass. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed. The layout for Concept 3 is presented in **Figure 2-3**.
- **Concept 4** – An exclusive eastbound right turn lane is proposed at the US 29 SB Off Ramp intersection. The layout for Concept 4 is presented in **Figure 2-4**.
- **Concept 5** – The intersection of Barracks Road with US 29 SB Off Ramp is proposed as a hybrid roundabout. The westbound approach is proposed to be two-lane. The layout for Concept 5 is presented in **Figure 2-5.**
- **Concept 5** - The intersection of Barracks Road with US 29 NB Off Ramp is proposed to be a hybrid roundabout. The westbound approach is proposed to be two-lane, and the eastbound approach is proposed as a single lane. The single eastbound lane approach opens up available space for a shared use path on the south side of Barracks Road through the interchange. The layout for Concept 5 is presented in **Figure 2-5.**
- **Concept 6** – Barracks Road with US 29 NB Off Ramp dual left turn movement is proposed for the northbound approach. The layout for Concept 6 is presented in **Figure 2-6**.
- **Concept 7** – Pedestrian improvements (10-foot Shared Use Path) are proposed for the south side of Barracks Road from the Bypass to Emmet Street. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed. The layout for Concept 7 is presented in **Figure 2-7.**
- **Concept 8** – US 29 NB Off Ramp freeway diverge segment storage length is proposed to be extended to be 600 feet long (full-width). The layout for Concept 8 is presented in **Figure 2-8**.

Cost estimates for the Build concepts were developed utilizing the 2021 VDOT Cost Estimating Manual methodologies and are presented in **Table 2-25**. VDOT developed the cost estimates for this study. Cost estimates were only prepared for the Smart Scale applications being applied for in 2024. Therefore, several individual improvement concepts were combined into grouped cost estimates. Details of these estimates are provided in **Appendix J.** Pedestrian improvements in the vicinity of intersections have been incorporated into the cost of the intersection improvements.

Table 2-25. Barracks Road (Route 654) – Build Concepts Cost Estimate (2024 Dollars)

Concept	Construction Contract	Preliminary Engineering	Right of Way & Utility	Total Estimated Project Costs
1 & 4	$16,285,500	$2,921,000	$7,999,800	**$27,206,300**
5 & 7	$47,124,000	$4,577,000	$14,170,000	**$65,889,000**

Figure 2-1. Barracks Road (Route 654) – Layout for Concepts 1

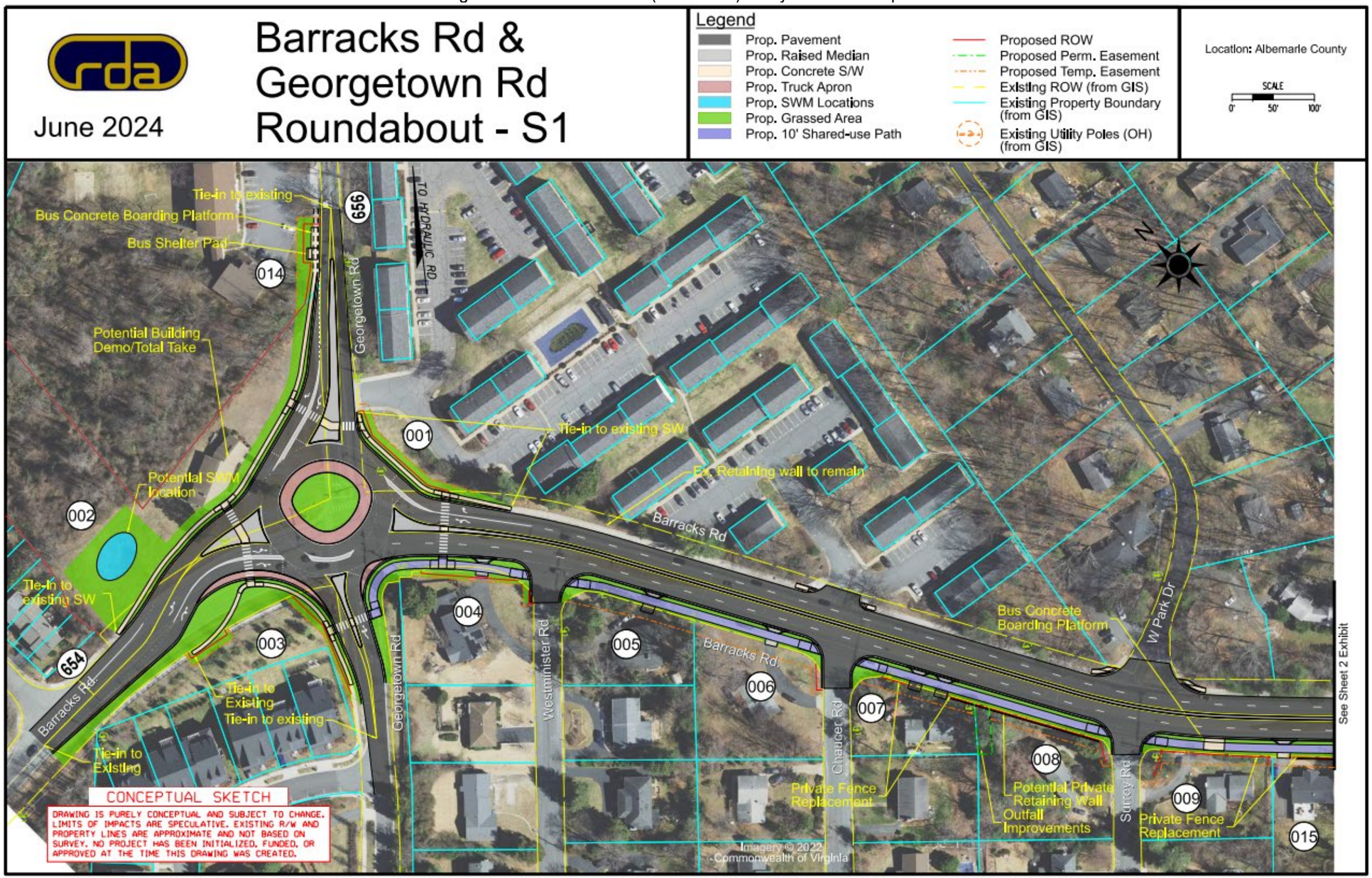


Figure 2-2. Barracks Road (Route 654) – Layout for Concepts 2

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Figure 2-3. Barracks Road (Route 654) – Layout for Concepts 3

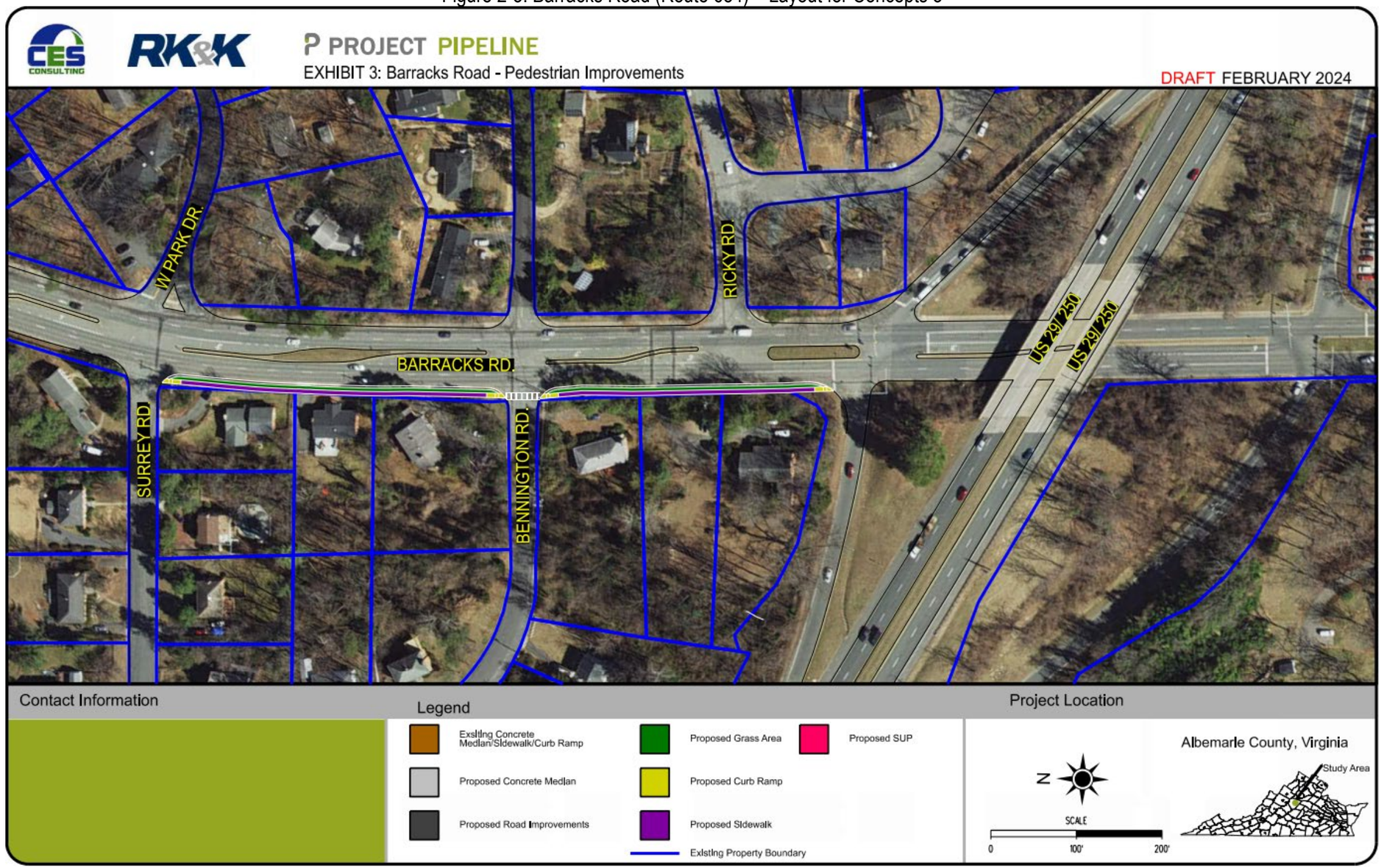


Figure 2-4. Barracks Road (Route 654) – Layout for Concept 4

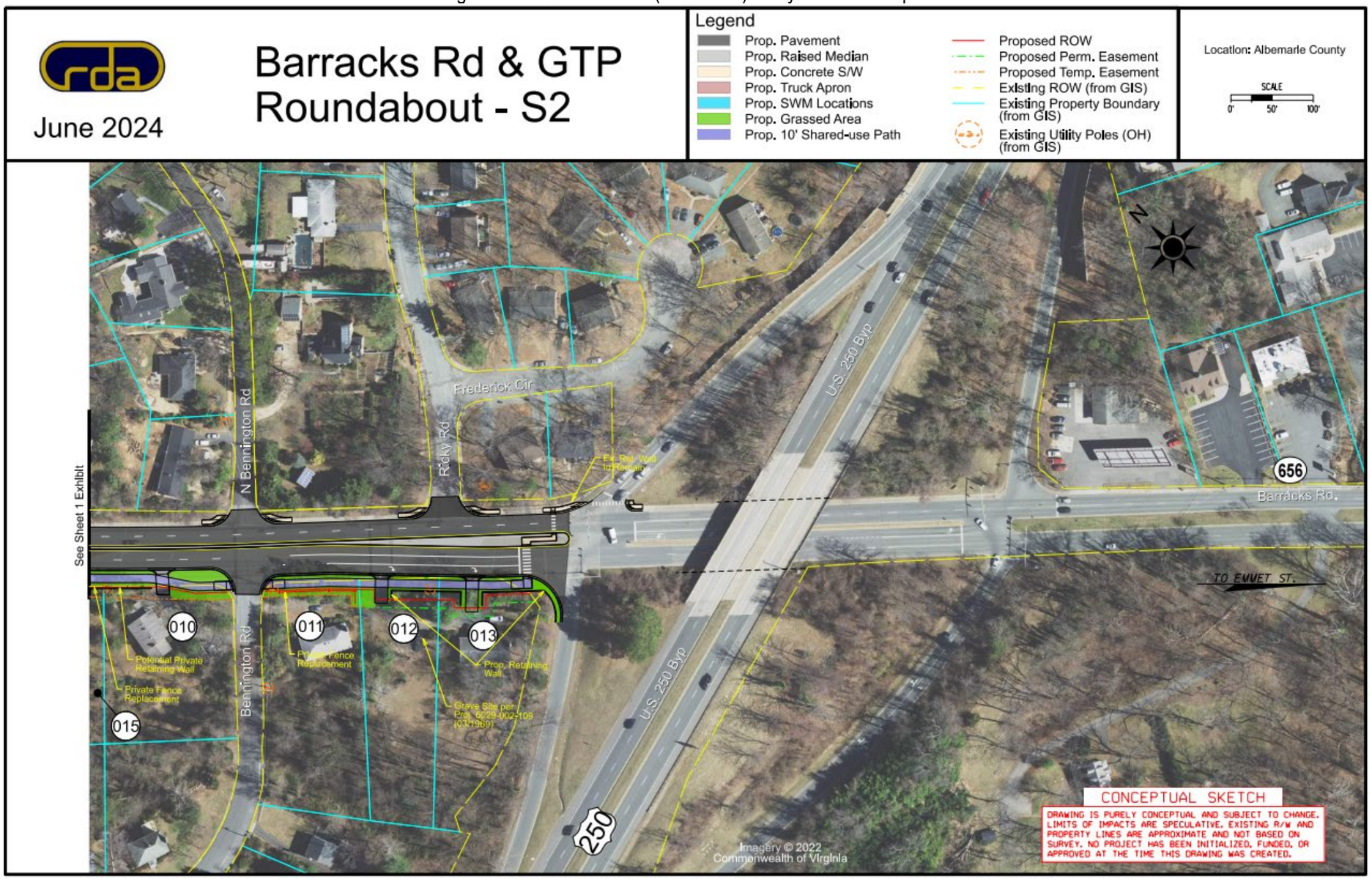


Figure 2-5. Barracks Road (Route 654) – Layout for Concept 5

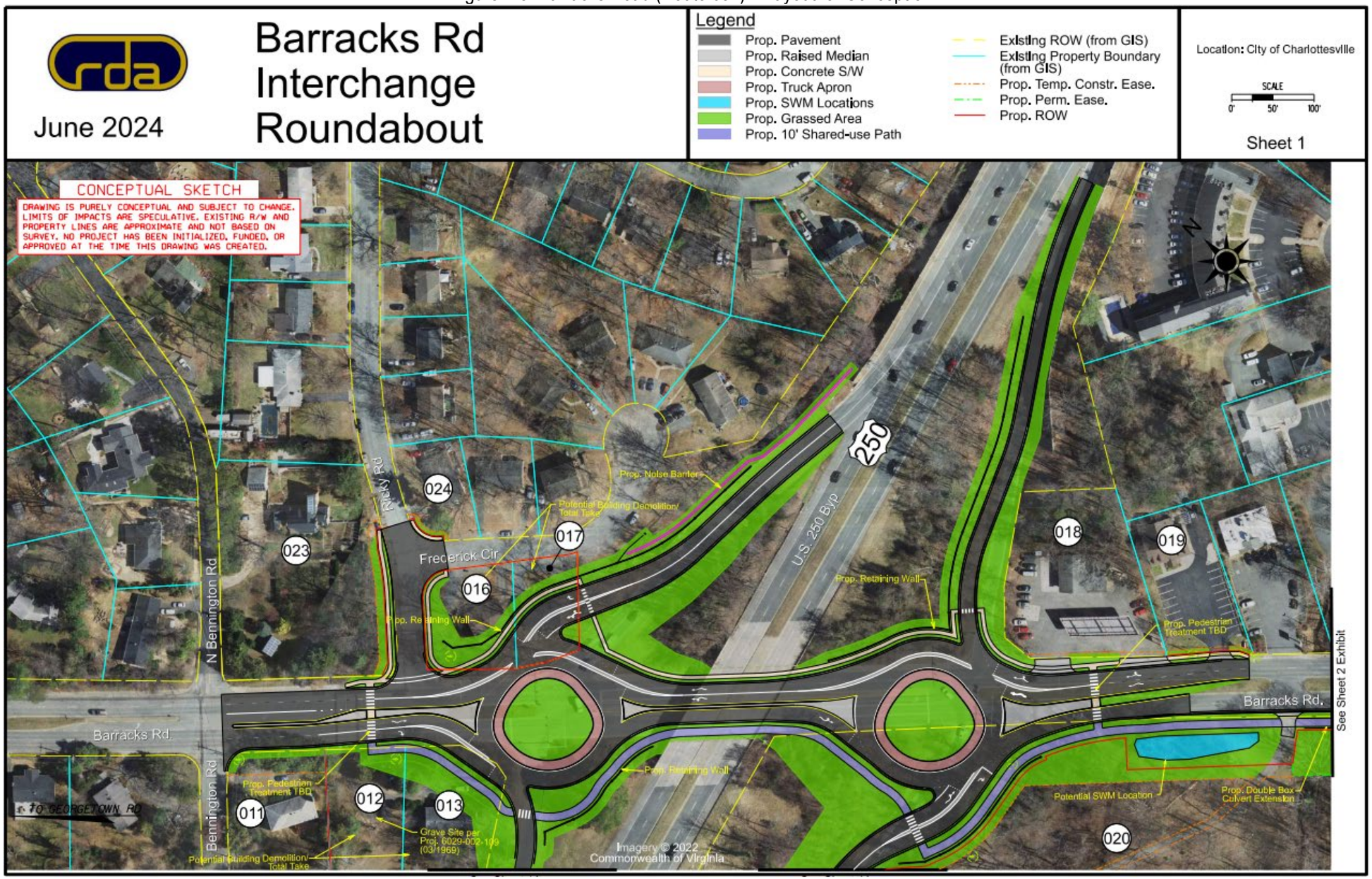


Figure 2-6. Barracks Road (Route 654) – Layout for Concept 6

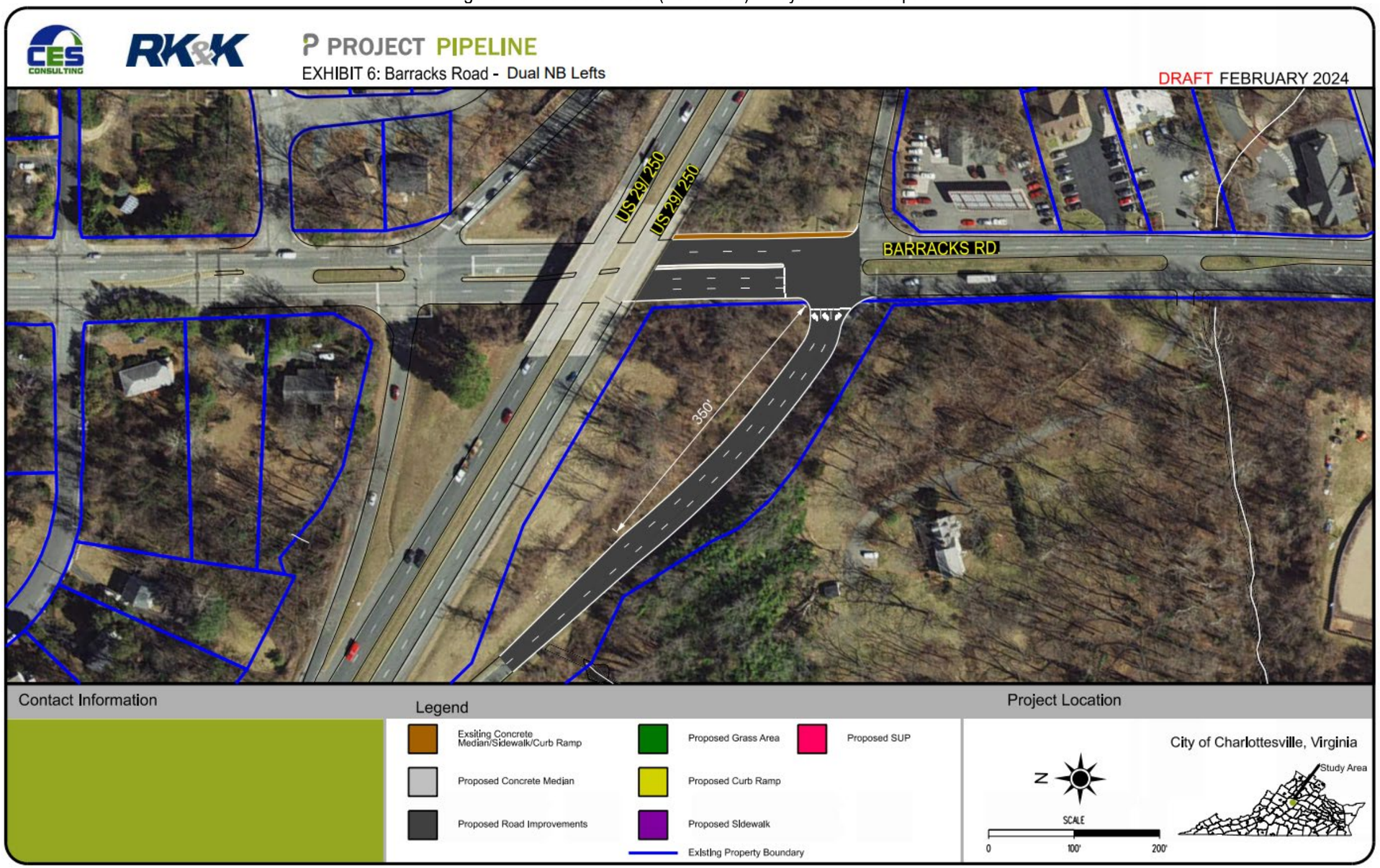


Figure 2-7. Barracks Road (Route 654) – Concept 7 (Segment 4)

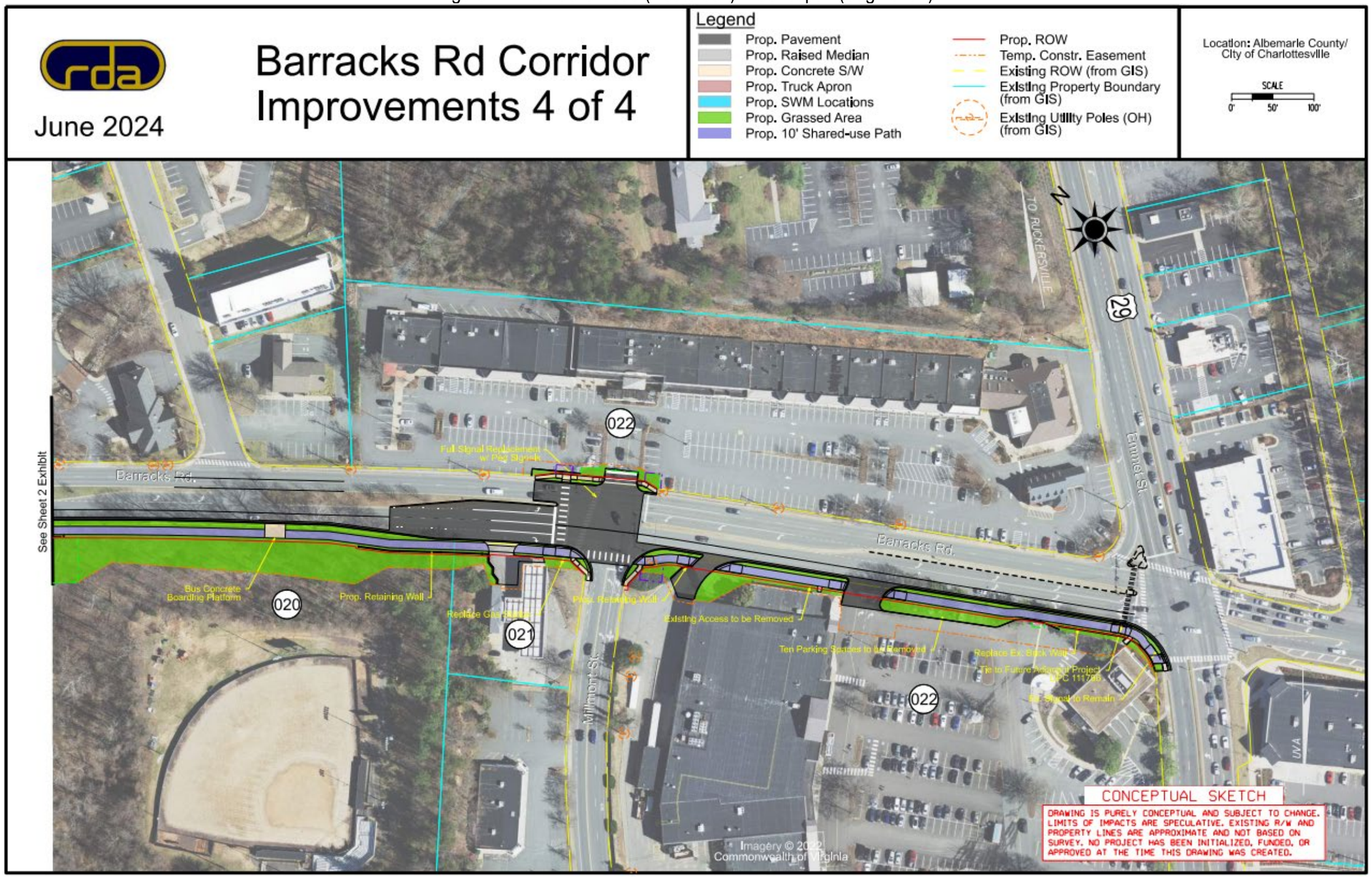
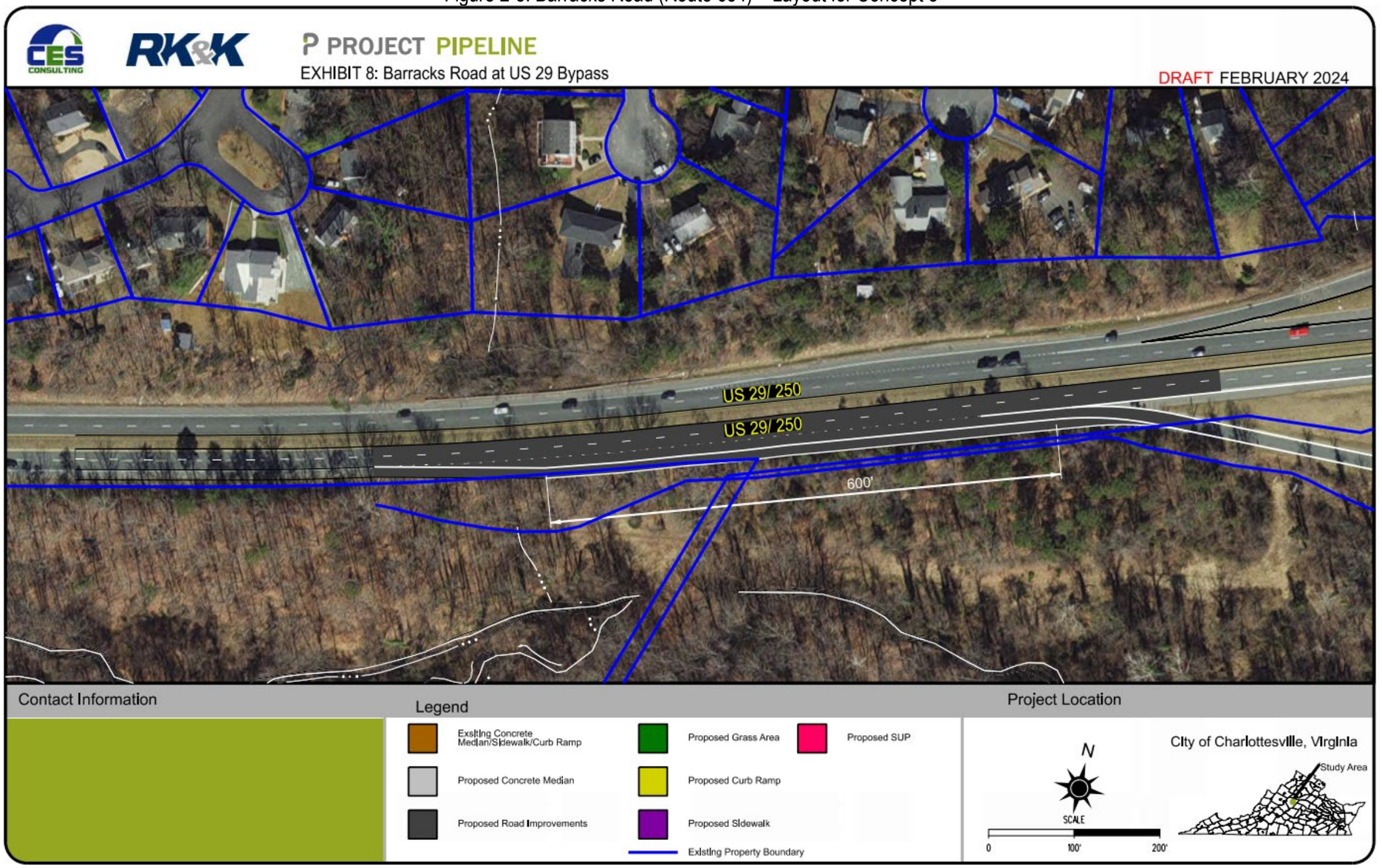


Figure 2-8. Barracks Road (Route 654) – Layout for Concept 8



g. Anticipated Safety Performance

To estimate the safety benefits of the identified concepts, a combination of crash modification factors (CMFs) from FHWA's Clearinghouse was utilized in his study. These factors are based on the results from multiple research studies, which looked at the safety benefits of the following build concepts:

- Build Concept 1: Convert Georgetown Road signalized Intersection to a hybrid roundabout.
- Build Concepts 2,3 & 7: Pedestrian Improvements – raised median and Shared Use Path on the south side of Barracks Road from (EB lanes shifted towards median).
- Build Concept 4: Add a dedicated eastbound right turn lane to the US 29 SB off-ramp signalized intersection.
- Build Concept 5: Convert the signalized intersection to a hybrid roundabout at the US 29 SB and NB Ramp intersections.
- Build Concept 6: Convert the northbound left turn to dual left turn lanes at the US 29 NB off-ramp intersection.
- Build Concept 8: Extend the US 29/250 NB off-ramp diverge segment to 600 feet.

Table 2-26 presents the expected CMFs for each concept and the intersections these scenarios apply under the Build concept. The table indicates that the proposed treatments are predicted to cause a significant reduction in crashes. Implementing roundabouts and alternative intersection designs reduces conflict points and improves traffic flow, resulting in safer conditions.

- CMF #1 – Change signalized intersection to a roundabout (CMF ID – 225) – CMF = 0.52, applicable to all crash types.
- CMF #2 – Install pedestrian facility (CMF ID – 4102) – CMF = 0.41, applicable to pedestrian crashes.
- CMF #3 – Install pedestrian facility (CMF ID – 4102) – CMF = 0.75, applicable to bicycle crashes.
- CMF #4 – Add dedicated right turn lane (CMF ID – 286 & 288) – CMF = 0.91, and 0.96, applicable to all crash types.
- CMF #5 – Change signalized intersection to a roundabout (CMF ID – 225) – CMF = 0.52, applicable to all crash types.
- CMF #6 – Install dual left turn (CMF 2013 FHWA) – CMF = 0.75, applicable to all crash types.
- CMF #7 – Install pedestrian facility (CMF ID – 4102) – CMF = 0.41, applicable to pedestrian crashes.
- CMF #8 – Extend NB 29 off-ramp deceleration lane to 600 feet (CMF ID – 4679) – CMF = 0.155; applicable to all crash types (ramp extension).

Table 2-26. Barracks Road (Route 654) – CMF Matrix for Build Concepts

Build Concept	CMF	1 0.52	2 0.41	3 0.75	4 0.91/0.96	5 0.52	6 0.26/0.29	7 0.41	8 0.155
1	Route 654 at Georgetown Road	✓	-	-	-	-	-	-	-
2 & 3	Route 654 Shared Use Path on the south side of Barracks Road	-	✓	✓	-	-	-	-	-
4	Route 654 at US 29 SB off-ramp		-	-	✓	-	-	-	-
5	Route 654 at US 29 SB off-ramp	-	-	-	-	✓			
5	Route 654 at US 29 NB off-ramp	-	-	-	-	✓	-	-	-
6	Route 654 at US 29 NB off-ramp	-	-	-	-	-	✓	-	-
7	Route 654 Shared Use Path on the south side of Barracks Road	-	-	-	-	-	-	✓	-
8	Route 654 at NB US 29 Bypass- Extend off-ramp	-	-	-	-	-	-	-	✓

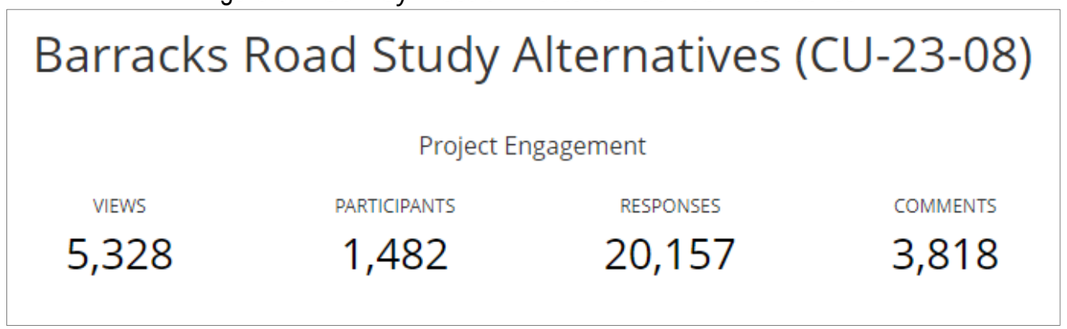
3. Chapter 3 – Public and Stakeholder Outreach and Feedback

The online survey presented the community with the improvement concepts described under the "Description of Build Concepts" section at eight locations along the Barracks Road corridor. The public was asked to rank these concepts by assigning star values one (1) through five (5), with one (1) star representing least desirable and five (5) stars for most desirable. The survey included improvements at the following locations:

1. Georgetown Road Roundabout
2. Access Management from Georgetown Road to Surrey Road
3. Access Management from Surrey Road to Bypass
4. SB off-ramp Barracks eastbound Right-Turn Lane
5. Dual roundabout interchange (teardrop)
6. NB US 29/250 off-Ramp – Dual Left-Turn Lanes.
7. Shared Use Path (Rivanna Trail or Millmont Street to Emmet Street)
8. Extend NB off-ramp diverge segment.

- **Figure 3-1** summarizes the overall participation in the survey. The survey responses and comments are presented below:

Figure 3-1. Survey Result – Route 654 Corridor Alternatives



A trend was observed with the written comments – the plurality of written comments was negative for all survey questions, even when the multiple-choice selections were a majority of favorable scores.

- **Figure 3-2** shows the survey results for the proposed roundabout at the intersection of Barracks Road and Georgetown Road. Most people (66%) selected 4 or 5 for this proposed improvement. As shown in **Figure 3-2**, the written comments showed approximately 43% of respondents expressed negative sentiments regarding the roundabout concept, around 32% of participants had neutral opinions, and 25% strongly supported implementing a roundabout at this intersection. A total of 1,447 people scored the roundabout, and 618 provided written comments.

Figure 3-2. Survey Result – Route 654 at Georgetown Road Roundabout

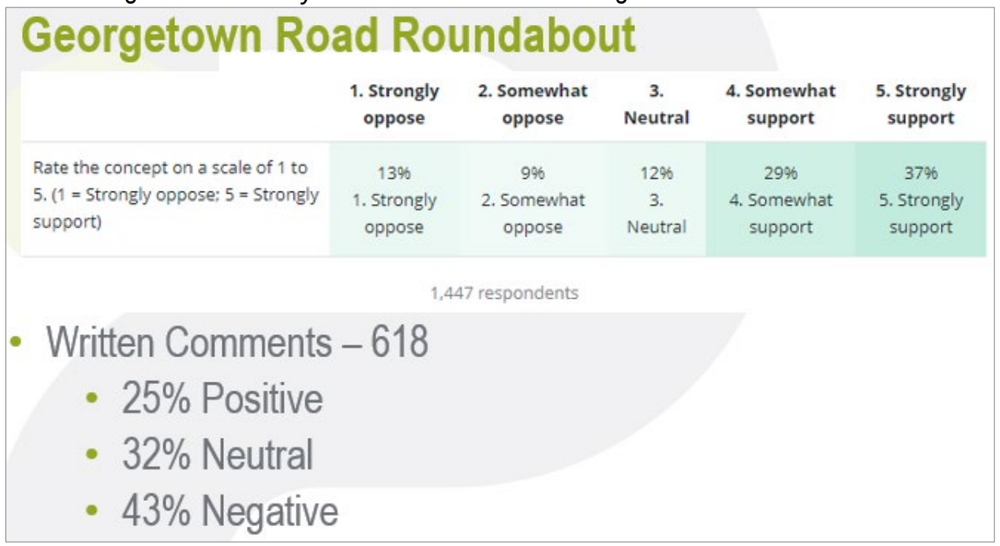


Figure 3-3 shows the survey results for the Do Nothing alternative at the intersection of Barracks Road and Georgetown Road. A small portion (25%) of respondents selected 4 or 5 for this proposed improvement. The rest of the scores were fairly evenly split among ratings 1-3. As shown in **Figure 3-3**, the written comments showed that approximately 53% of respondents expressed negative sentiments regarding the Do Nothing alternative, around 33% of participants had neutral opinions, and 14% supported implementing a roundabout. A total of 1,264 people scored the Do Nothing alternative, and 317 provided written comments.

Figure 3-3. Survey Result – Route 654 at Georgetown Road Do Nothing

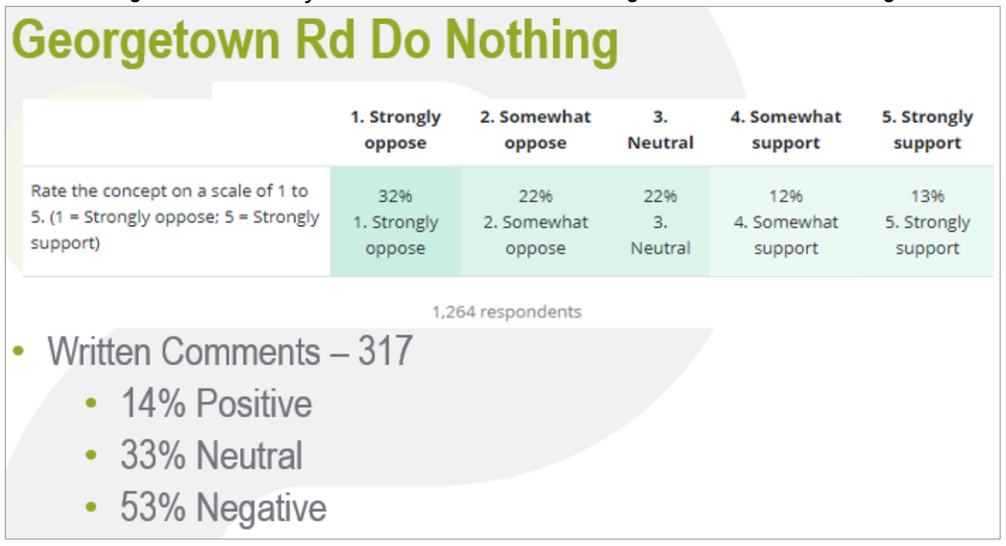
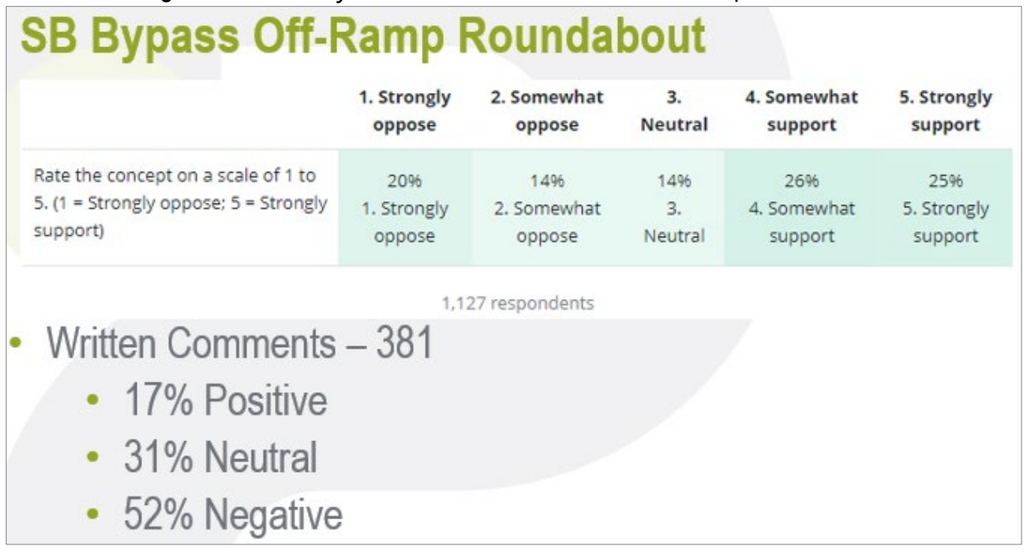


Figure 3-4. Survey Result – Route 654 at SB Off-Ramp Roundabout



- **Figure 3-4** shows the survey results for the proposed roundabout at the intersection of Barracks Road and the SB Bypass Off-Ramp. A slim majority (51%) of respondents selected 4 or 5 for this proposed improvement. The rest of the scores were fairly evenly split among 1-3. As shown in **Figure 3-4**, the written comments showed that approximately 52% of respondents expressed negative sentiments regarding the roundabout concept, around 31% of participants had neutral opinions, and 17% supported implementing a roundabout. A total of 1,127 people scored the roundabout, and 381 provided written comments.

Figure 3-5 shows the survey results for the proposed EB right turn lane at the intersection of Barracks Road and the SB Bypass Off-Ramp. A slim majority (52%) of respondents selected 4 or 5 for this proposed improvement. A significant portion (27%) selected 3, and only 21% selected 1 or 2. As shown in **Figure 3-5**, the written comments showed approximately **40%** of respondents expressed negative sentiments regarding the EB right turn lane concept, around 35% of participants had neutral opinions, and 26% supported implementing a roundabout. A total of 1,044 people scored the roundabout, and 301 provided written comments.

Figure 3-5. Survey Result – Route 654 at SB Off-Ramp EB Right Turn Lane

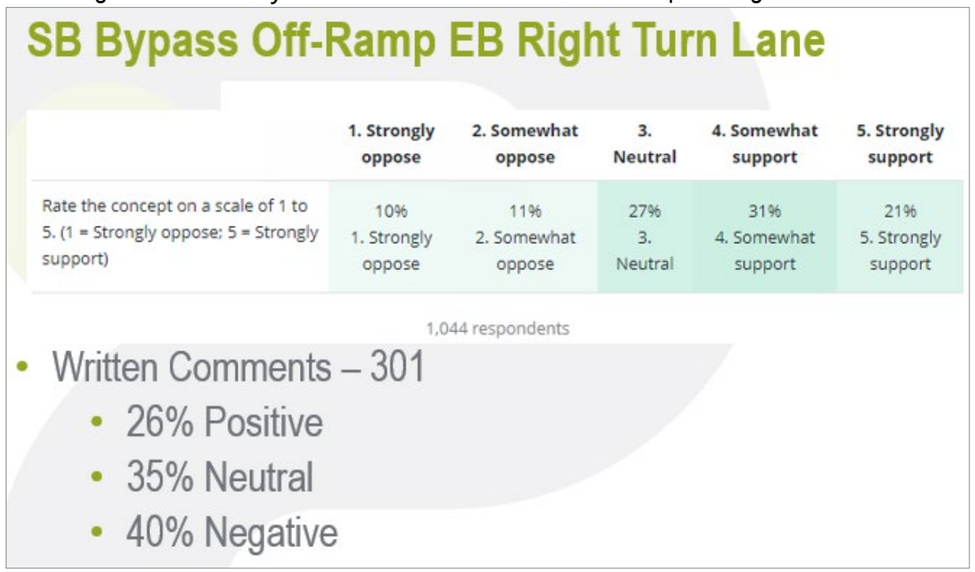


Figure 3-6. Survey Result – Route 654 at SB Off-Ramp Do Nothing

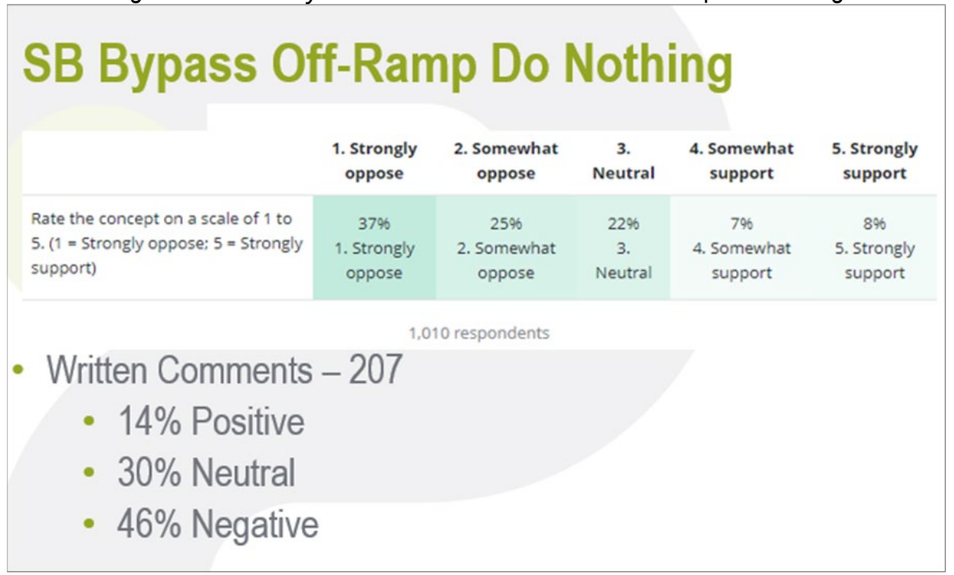


Figure 3-6 shows the survey results for the Do Nothing alternative at the intersection of Barracks Road and the SB Bypass Off-Ramp. A slim percentage (15%) of respondents selected 4 or 5 for this proposed improvement. The rest of the scores were spread among 1-3. As shown in **Figure 3-6**, the written comments showed approximately **46%** of respondents expressed negative sentiments regarding the Do Nothing alternative, around 30% of participants had neutral opinions, and 14% supported the Do Nothing alternative. A total of 1,010 people scored the Do Nothing alternative, and 207 provided written comments.

- **Figure 3-7** displays the survey results for the proposed roundabout at the intersection of Barracks Road and the NB Bypass Off-Ramp. Most respondents (55%) selected 4 or 5 for this proposed improvement. However, a significant portion (34%) selected 1 or 2. As shown in **Figure 3-7** , 52% of the written comments expressed negative sentiments regarding the roundabout concept, 31% of participants had neutral opinions, and 17% of respondents showed support for implementing a roundabout. A total of 923 people scored the roundabout, and 259 provided written comments.

Figure 3-7. Survey Result – Route 654 at NB Off-Ramp Roundabout

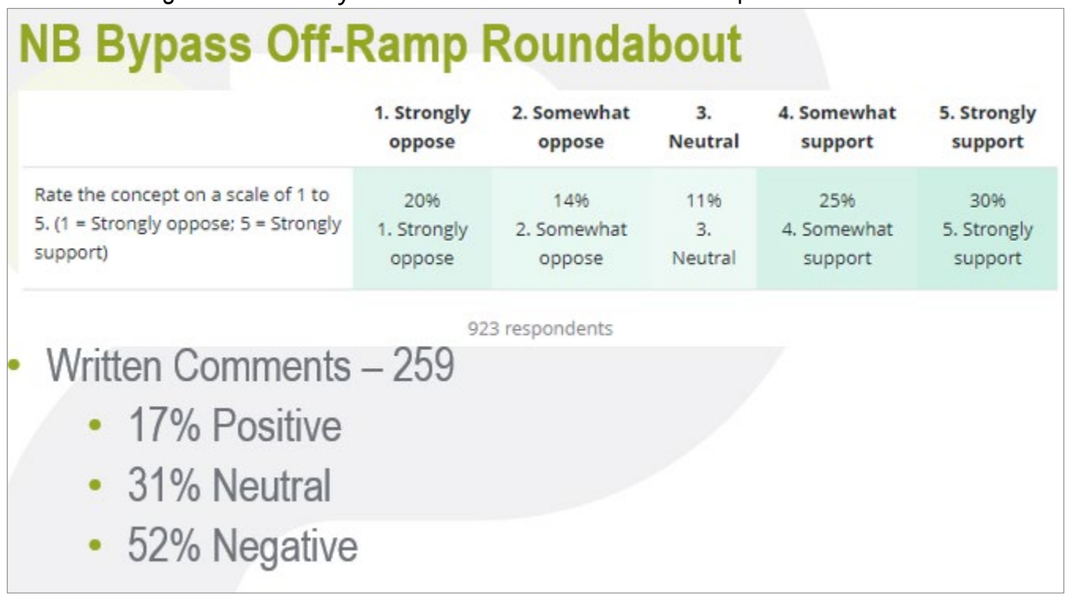
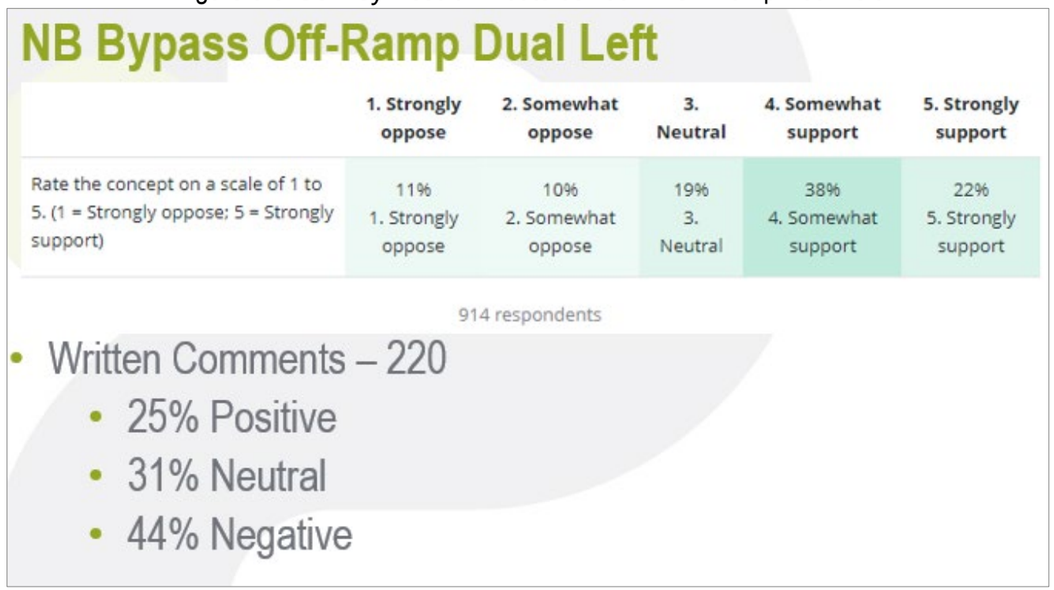


Figure 3-8. Survey Result – Route 654 at NB Off-Ramp Dual Left



- **Figure 3-8** presents the survey results for the proposed dual left at the intersection of Barracks Road at the NB Bypass Off-Ramp. A strong majority (60%) selected 4 or 5, 19% selected 3, and only 21% selected 1 or 2. **Figure 3-8** also summarizes the written comment sentiment, **44%** of respondents expressed negative sentiments regarding the dual left concept, 31% of participants had neutral opinions, and 25% supported implementing a dual left turn. A total of 914 people scored the roundabout, and 220 provided written comments.

- **Figure 3-9** displays the survey results for the Do Nothing alternative at the intersection of Barracks Road and the NB Bypass Off-Ramp. A slim percentage (10%) of respondents selected 4 or 5 for this proposed improvement. However, a significant portion (69%) selected 1 or 2. As shown in **Figure 3-9**, 58% of the written comments expressed negative sentiments regarding the Do Nothing alternative, 32% of participants had neutral opinions, and 10% of respondents showed support for implementing dual left turn. A total of 877 people scored the Do Nothing alternative, and 148 provided written comments.

Figure 3-9. Survey Results – Route 654 at NB Off-Ramp

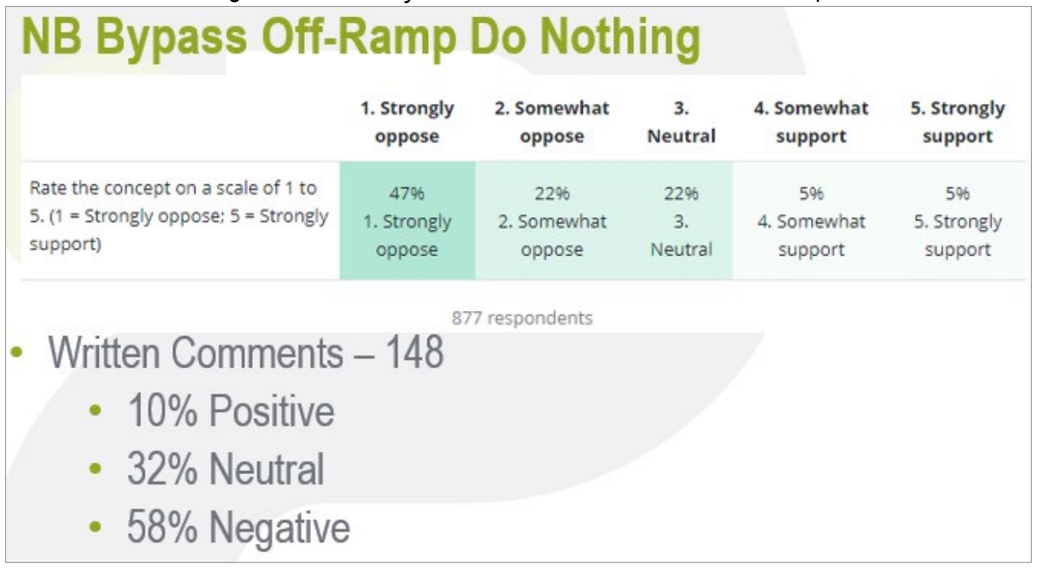
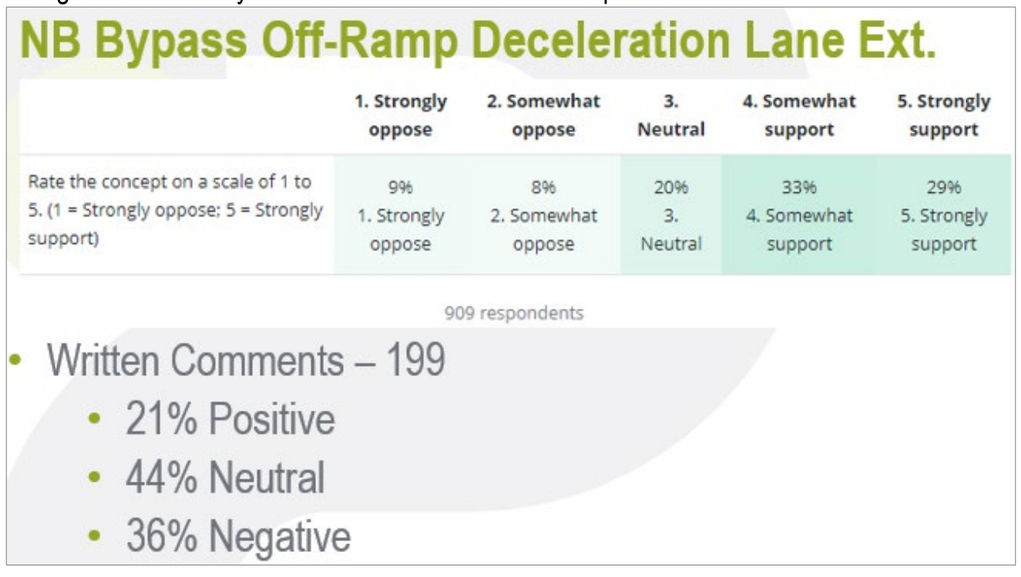


Figure 3-10. Survey Result – US 29/250 NB Off-Ramp Deceleration Lane Extension



- **Figure 3-10** shows the survey results for the proposed deceleration lane extension of the US 29/250 NB Off-Ramp. A strong majority (62%) selected 4 or 5, 20% chose 3, and only 17% selected 1 or 2. **Figure 3-10** displays the summary of the written comments - **36%** of respondents expressed negative sentiments regarding the deceleration lane extension concept, 44% of participants had neutral opinions, and 21% supported implementing the extension. A total of 909 people scored the deceleration lane, and 199 provided written comments.

- **Figure 3-11** displays the survey results for the proposed access management and Shared Use Path (SUP) concept from Georgetown Road to the Bypass. Most respondents (56%) choose 4 or 5, 19% choose 3, and 25% choose 1 or 2. The written comment summaries displayed in **Figure 3-11** show **that 40% of respondents expressed negative sentiments regarding access management and SUP concept, 33% of participants had neutral opinions, and 27% supported** implementing the improvements. A total of 846 people scored the access management and SUP, and 223 provided written comments.

Figure 3-11. Survey Result – Route 654 From Georgetown Road to Bypass Ramps (SUP)

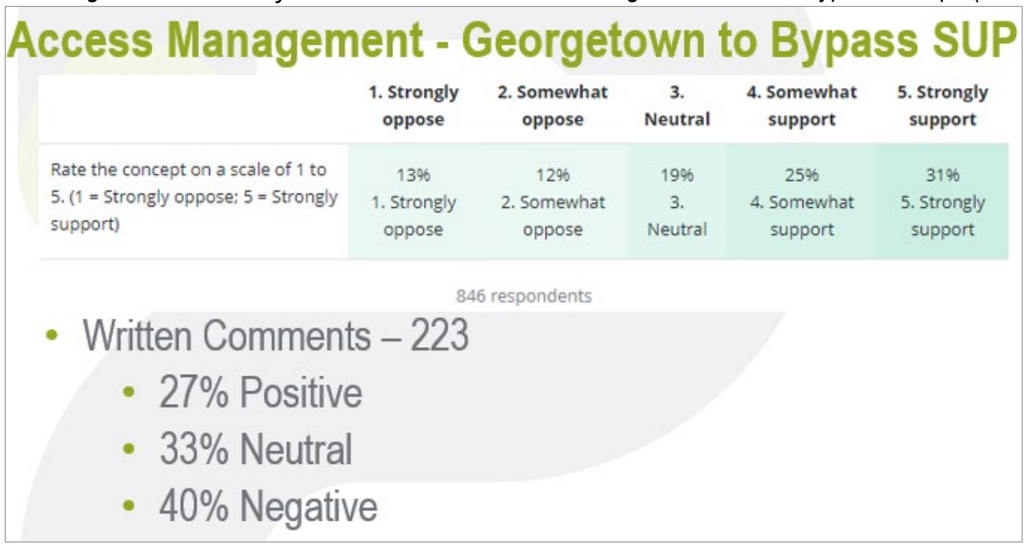
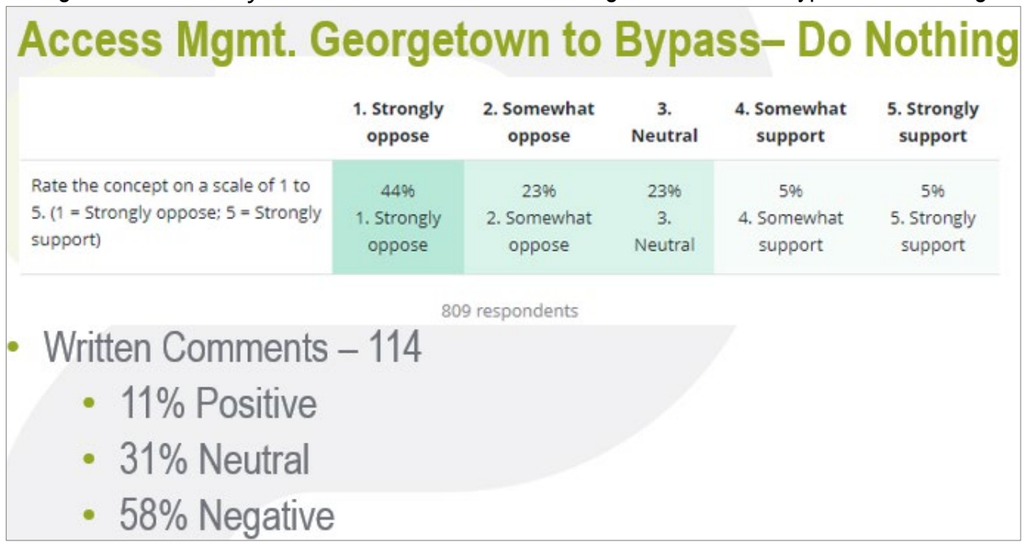


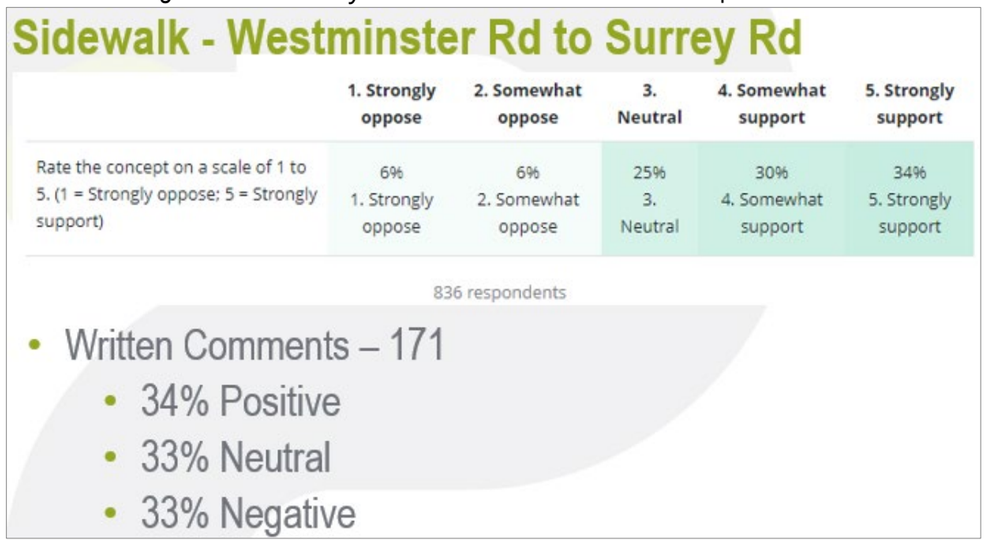
Figure 3-12. Survey Result – Route 654 From Georgetown Road to Bypass Do Nothing



- **Figure 3-12** displays the survey results for the Do Nothing alternative about the segment from Georgetown Road to the Bypass. A slim percentage (10%) of the respondents choose 4 or 5, 23% choose 3, and 67% choose 1 or 2. The written comment summaries in **Figure 3-12** show **that 58% of respondents expressed negative sentiments regarding the Do Nothing alternative, 31% of participants had neutral opinions, and 11% supported** the Do Nothing alternative. A total of 809 people scored the Do Nothing alternative, and 114 provided written comments.

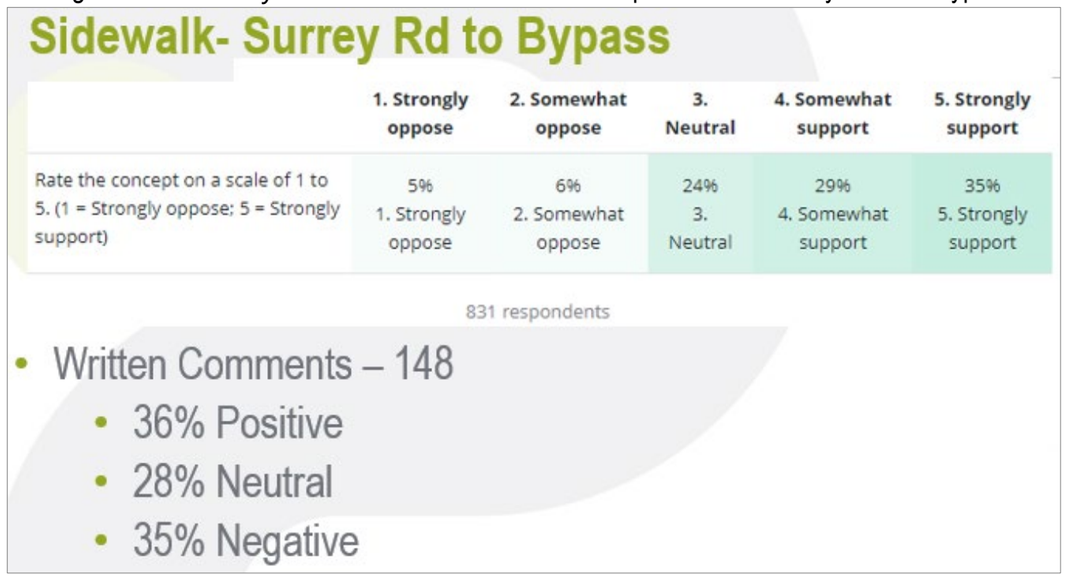
- **Figure 3-13** exhibits the survey results for the proposed sidewalk from Westminster Road to Surrey Road. Respondents strongly supported this improvement, with 64% selecting a score of 4 or 5, 25% selecting 3, and only 12% choosing 1 or 2. **Figure 3-13** also summarizes the written comments - 33% of respondents expressed negative sentiments regarding the sidewalk concept, 33% of participants had neutral opinions, and 34% of respondents supported implementing the sidewalk. A total of 836 people scored the sidewalk, and 171 provided written comments.

Figure 3-13. Survey Result – Route 654 Sidewalk Improvements



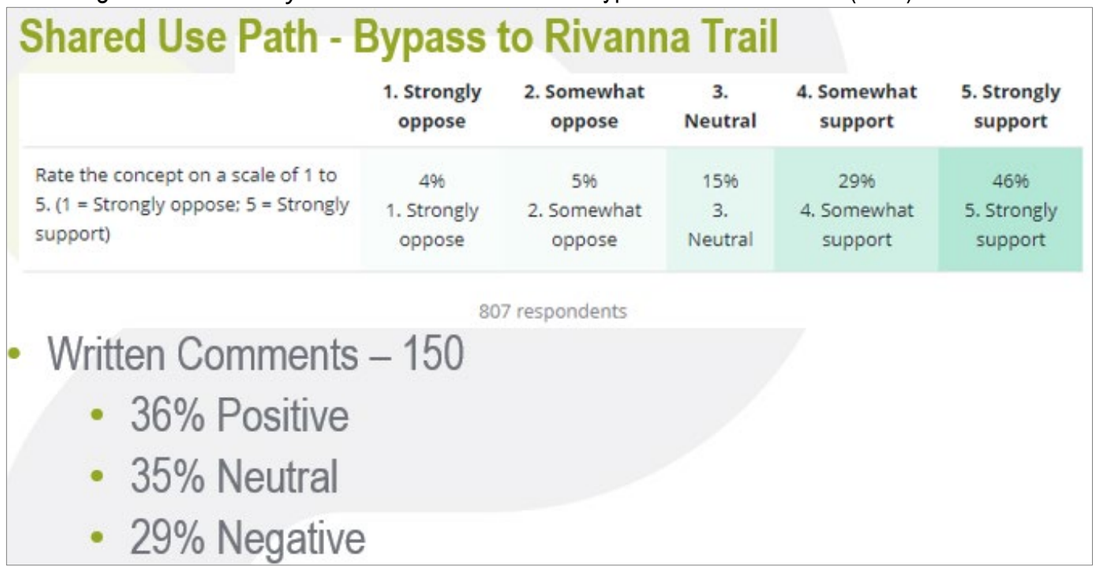
- **Figure 3-14** presents the survey results for the proposed sidewalk from Surrey Road to Bypass. A strong majority (64%) scored the proposed improvement 4 or 5, 24% chose 3, and only 11% chose 1 or 2. **Figure 3-14** also summarizes the written comments - 35% of respondents expressed negative sentiments regarding the sidewalk concept, 28% of participants had neutral opinions, and 36% supported impleFigure 3-15menting the sidewalk. A total of 831 people scored the sidewalk, and 148 provided written comments.

Figure 3-14. Survey Result – Route 654 Sidewalk Improvements Surrey Road to Bypass



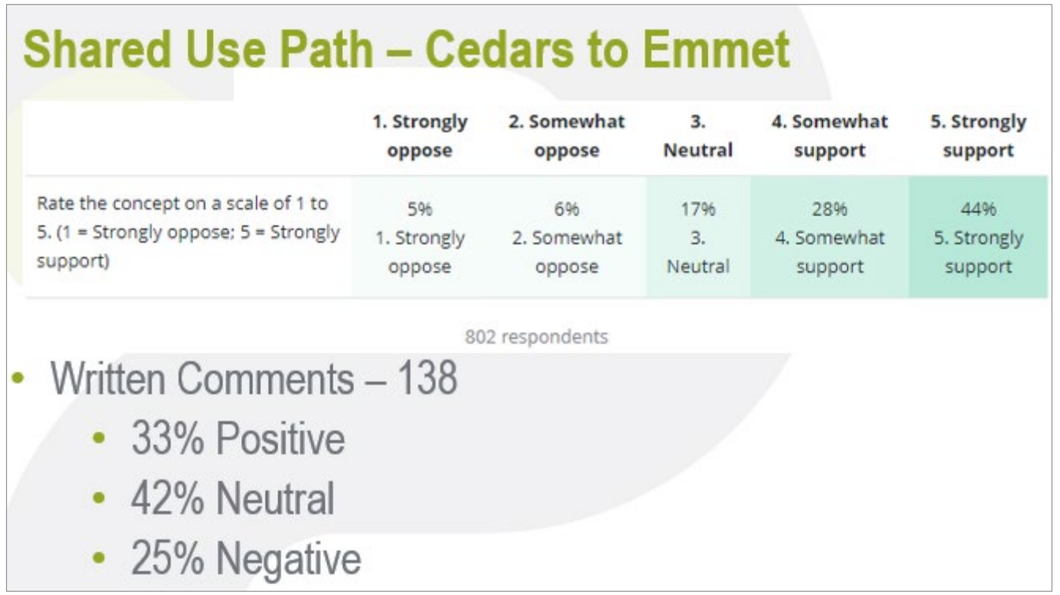
- **Figure 3-15** shows the survey results for the proposed Shared Use Path (SUP) from the Bypass to Rivanna Trail. An overwhelming majority (75%) scored it 4 or 5, 15% chose 3, and only 9% chose 1 or 2. As shown in **Figure 3-15** , the written comments showed **that 29% of respondents expressed negative sentiments regarding the SUP concept, 35% of participants had neutral opinions, and 36% supported** implementing the SUP. A total of 807 people scored the SUP, and 150 provided written comments.

Figure 3-15. Survey Result – Route 654 From Bypass to Rivanna Trail (SUP)



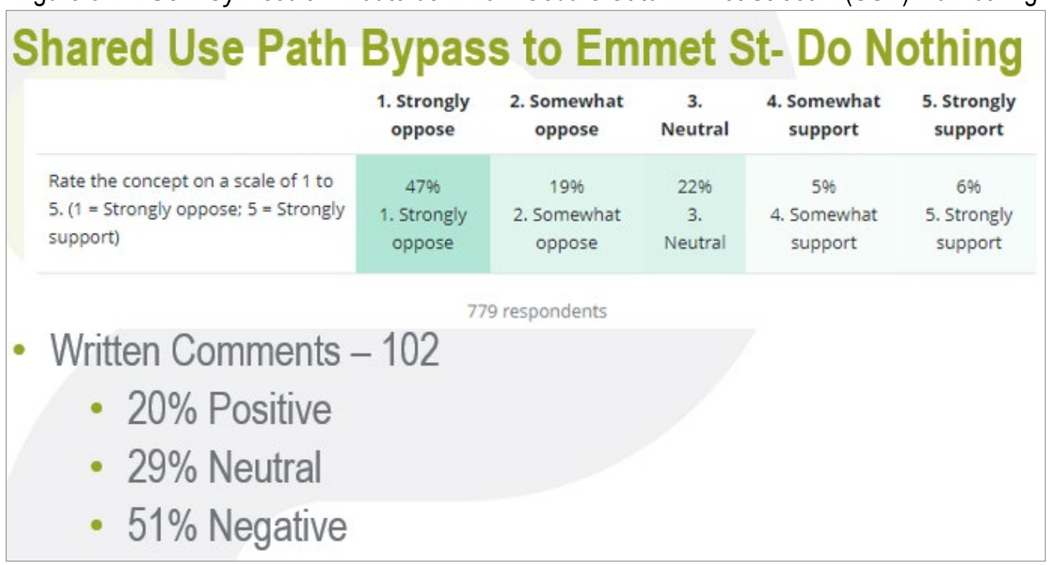
- **Figure 3-16** displays the survey results for the proposed Shared Use Path (SUP) from Cedars Court to Emmet Street N. Trail. An overwhelming majority (72%) scored it 4 or 5, 17% chose 3, and only 11% chose 1 or 2. The written comments are also summarized in **Figure 3-16**; 25% of respondents expressed negative sentiments regarding the SUP concept, 42% of participants had neutral opinions, and 33% supported implementing the SUP. A total of 802 people scored the SUP, and 138 provided written comments.

Figure 3-16. Survey Result – Route 654 From Cedars Ct to Emmet Street N (SUP)



- **Figure 3-17** displays the survey results for the Do Nothing alternative segment from the Bypass to Emmet Street N. A slim majority (11%) of respondents selected 4 or 5 for the Do Nothing alternative. However, a significant portion (66%) selected 1 or 2. As shown in **Figure 3-17**, 51% of the written comments expressed negative sentiments regarding the Do Nothing alternative, 29% of participants had neutral opinions, and 20% of respondents supported the Do Nothing alternative. A total of 779 people scored the Do Nothing alternative, and 102 provided written comments.

Figure 3-17. Survey Result – Route 654 From Cedars Ct to Emmet Street N (SUP) Do Nothing



4. Chapter 4 – Investment Strategy

VDOT facilitates access to multiple funding sources for transportation improvement projects. Below is a description of the most relevant to the Pipeline Initiative. Additionally, **Table 4-1** shows potential funding sources for the study recommendations.

a. SMART SCALE

- A statewide program that distributes funding based on a transparent and objective evaluation of projects that will determine how effectively they help the state achieve its transportation goals.
- Two main pathways to funding within the SMART SCALE process are the Construction District Grant Program (DGP) and the High Priority Projects Program (HPPP).
- Applications may be submitted through the SMART Portal by regional entities, including Metropolitan Planning Organizations (MPOS) and Planning District Commissions (PDCs), public transit agencies, and counties, cities, and towns that maintain their own infrastructure.
- Approximately $500-600 million in each program is expected to be available per funding cycle. Funding includes both state and federal sources.

b. Transportation Alternatives (TAP)

- This program is intended to help sponsors fund projects that expand non-motorized travel choices and enhance the transportation experience. It focuses on providing pedestrian and bicycle facilities and other community improvements.
- TAP funds are only available on a reimbursement basis. The program will reimburse up to a maximum of 80% of the eligible project costs and requires a minimum of 20% local match. It requires strict adherence to federal and state regulations, including Americans with Disability Act (ADA) design standards.
- Approximately $20 million is available per year with a maximum request of $1 million per year ($2 million per application). All funding is federal.

c. Revenue Sharing (RS)

- This program provides additional funding for use by a county, city, or town to construct, reconstruct, improve, or maintain the highway systems within such county, city, or town, and for eligible rural additions in certain counties of the Commonwealth.
- The RS program will match, dollar for dollar, eligible project costs up to limitations s pecified in CTB Policy.
- Approximately $100 million in state funding is available per year. All funding is non-federal.

d. Other Funding Sources

- **Local Funds:** Localities may also direct funds themselves in order to procure transportation projects. This ability may vary depending on the locality, the amount of transportation-related funding allocated to the locality by the state, and other funding availability for transportation projects.
- **Federal Grant Programs:** Additional discretionary grant funding opportunities are available through the recent Infrastructure Investment and Jobs Act (Public Law 117-58).

Table 4-1. Barracks Road – Potential Funding Sources

Project	*SMART SCALE*	*TAP*	*RS*	*Locality Funding*
Build Concept 1	✓		✓	✓
Build Concept 2	✓	✓	✓	✓
Build Concept 3	✓	✓	✓	✓
Build Concept 4	✓		✓	✓
Build Concept 5	✓		✓	✓
Build Concept 6	✓		✓	✓
Build Concept 7	✓	✓	✓	✓
Build Concept 8	✓		✓	✓

5. Appendix A – FHWA STEAP Tool Report

6. Appendix B – FR300 Crash Diagrams

7. Appendix C – Raw Traffic Counts

8. Appendix D – Volume Distribution

10. Appendix E – Traffic Analysis Results

11. Appendix F – Public Input Results

12. Appendix G – Traffic Forecasting

13. Appendix H – Concepts

14. Appendix I – Cost Estimating