



PROJECT PIPELINE

Ivy Road (US 250 BUS)

CITY OF CHARLOTTESVILLE /
ALBEMARLE COUNTY CITY OF
CHARLOTTESVILLE / ALBEMARLE
COUNTY



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Chapter 1 – Needs Evaluation and Diagnosis

Introduction

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



Figure 1-1. Project Pipeline Objectives

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

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**.

Background

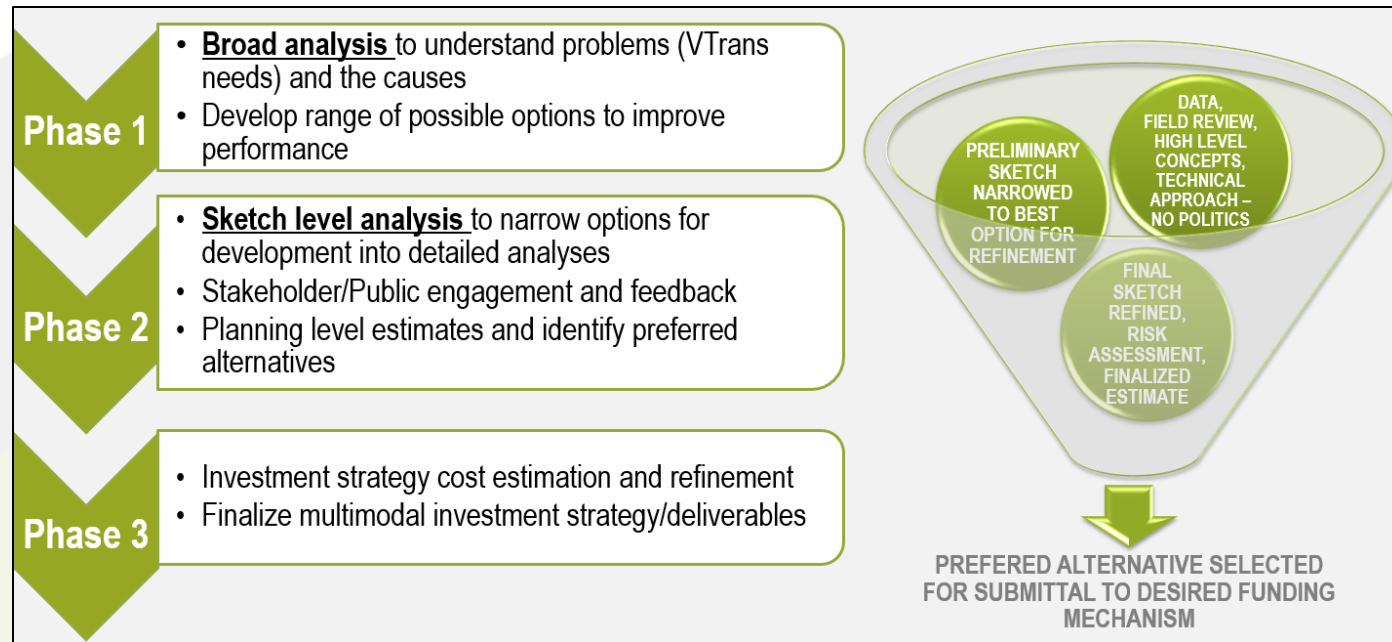


Figure 1-2. Study Phase Methods and Solutions

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						

Study Area

The Ivy Road (US 250 BUS) study corridor from Ednam Drive to Alderman Road is located in the City of Charlottesville and Albemarle County, Virginia. Ivy Road is classified as Other Principal Arterial within the study area. The study area also includes the Route 29/250 Bypass interchange movements with Ivy Road and Old Ivy Road. The posted speed limit is 35 MPH on Ivy Road and 55 MPH on the Route 29/250 Bypass. The length of the Ivy Road study corridor is 1.86 miles. A map detailing the locations of the study intersections along Ivy Road is shown below in **Figure 1-4**.

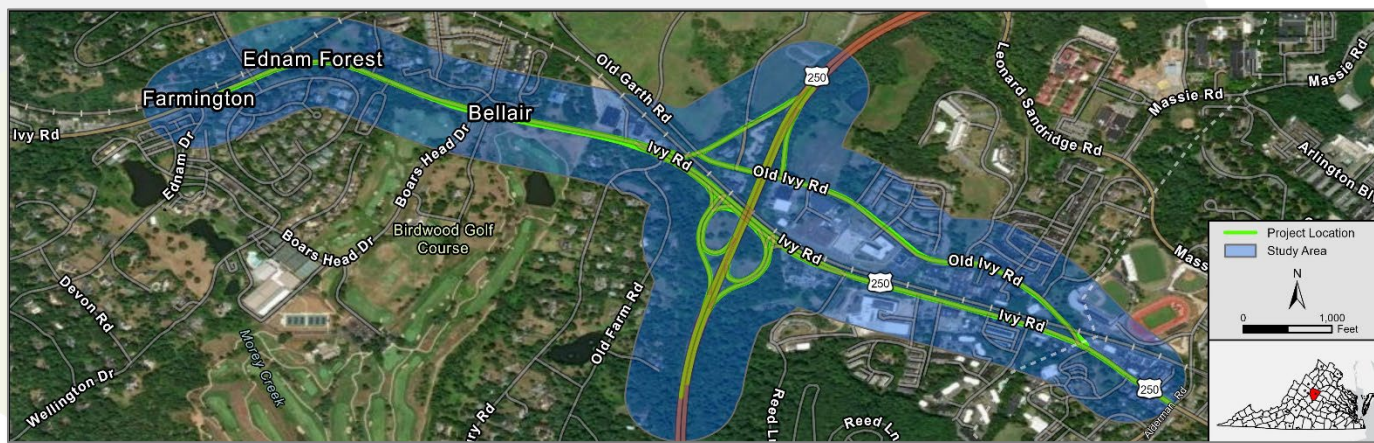


Figure 1-4. Ivy Road Study Area Map

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 Ivy Road study corridor, were identified as 'Very High' for Transit Access, Transit Access for Equity Emphasis, Transportation Demand Management, and 'High' for Congestion Mitigation, and 'Medium' Bicycle Access, and Capacity Preservation.

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

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:

- The majority of the population (83%) within the study area is between ages 18 and 64, as shown in **Figure 1-5**.
- There is a high personal vehicle ownership, with 46% of households owning one vehicle and 28% owning two. Only 16% of households do not own a personal vehicle, as shown in

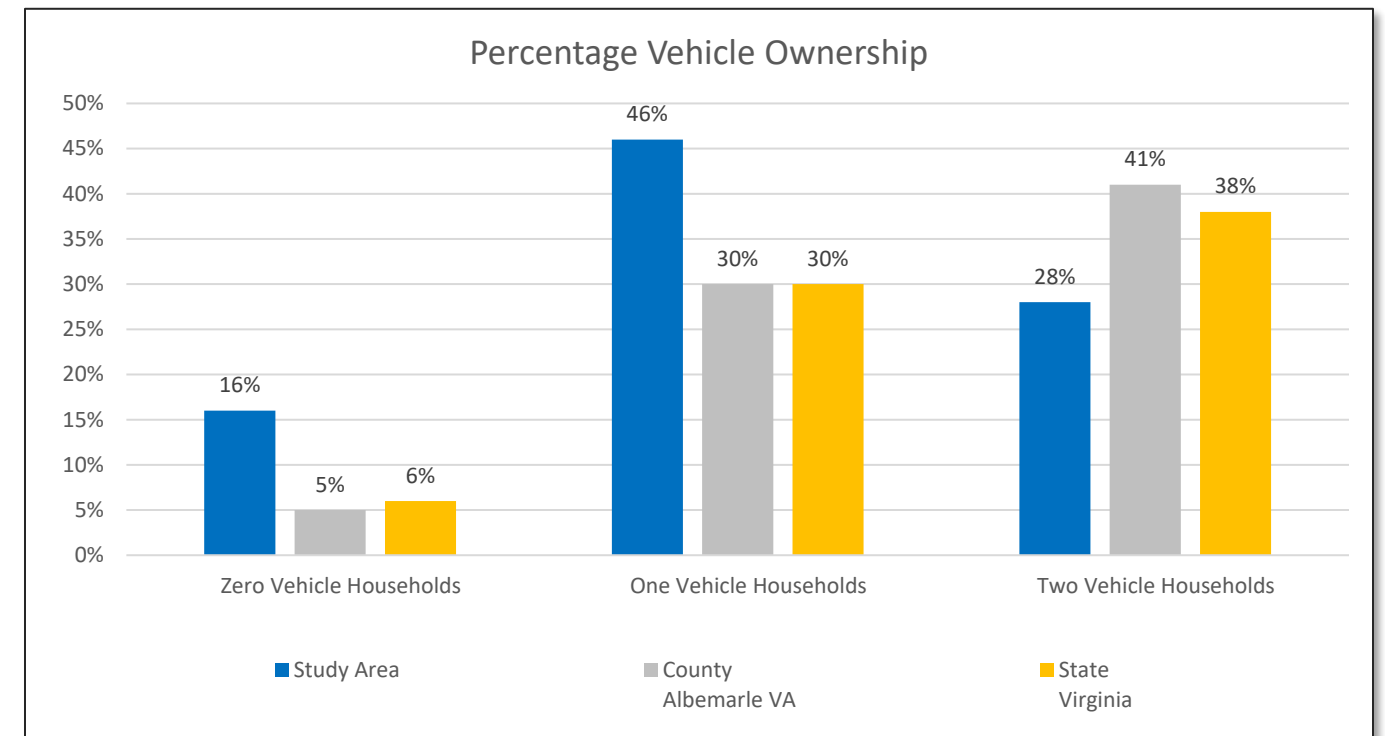


Figure 1-6.

- Of the non-English speakers (age 5+) at home, everyone speaks English very well, as shown in

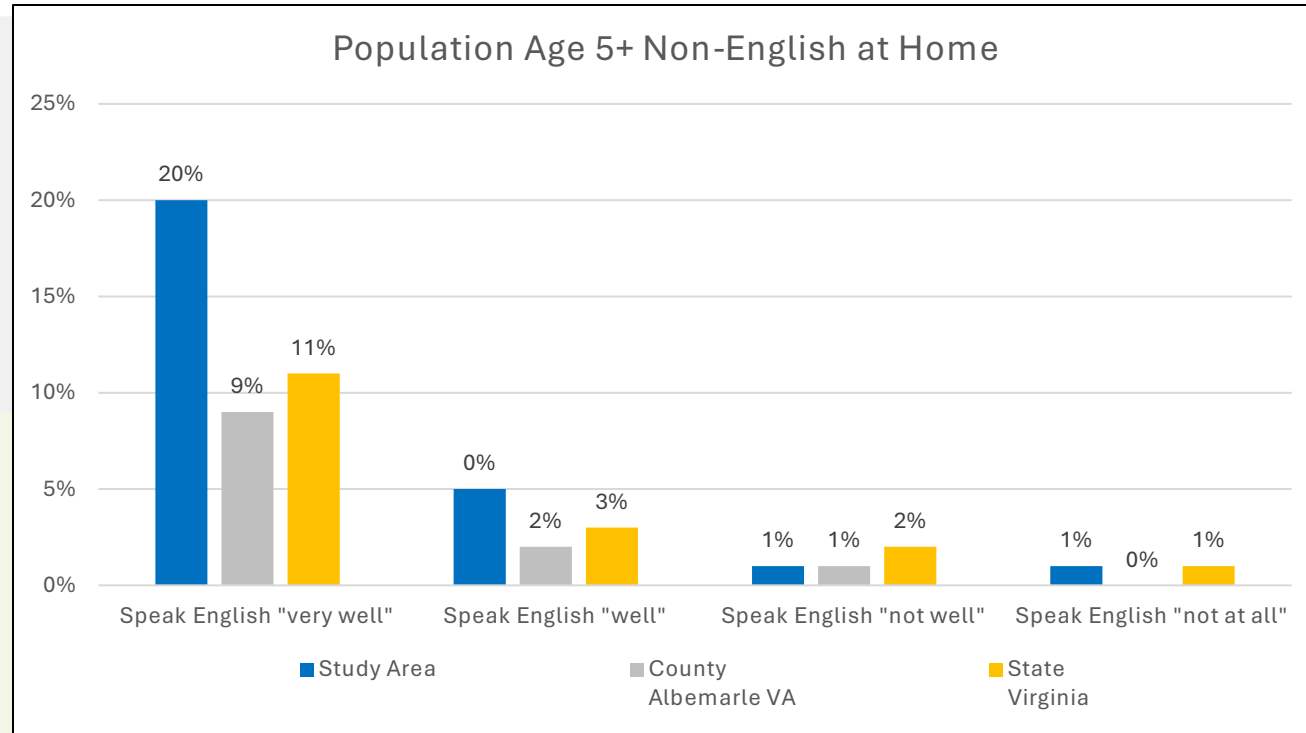


Figure 1-7.

- Compared to the State of Virginia, Albemarle County has a lower number of 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, 42% have household income greater than \$75,000, as shown in **Figure 1-9**. This is the same percentage as the City of Charlottesville. 21% of the study area has an annual household income below \$15,000; most of this population is likely University students.

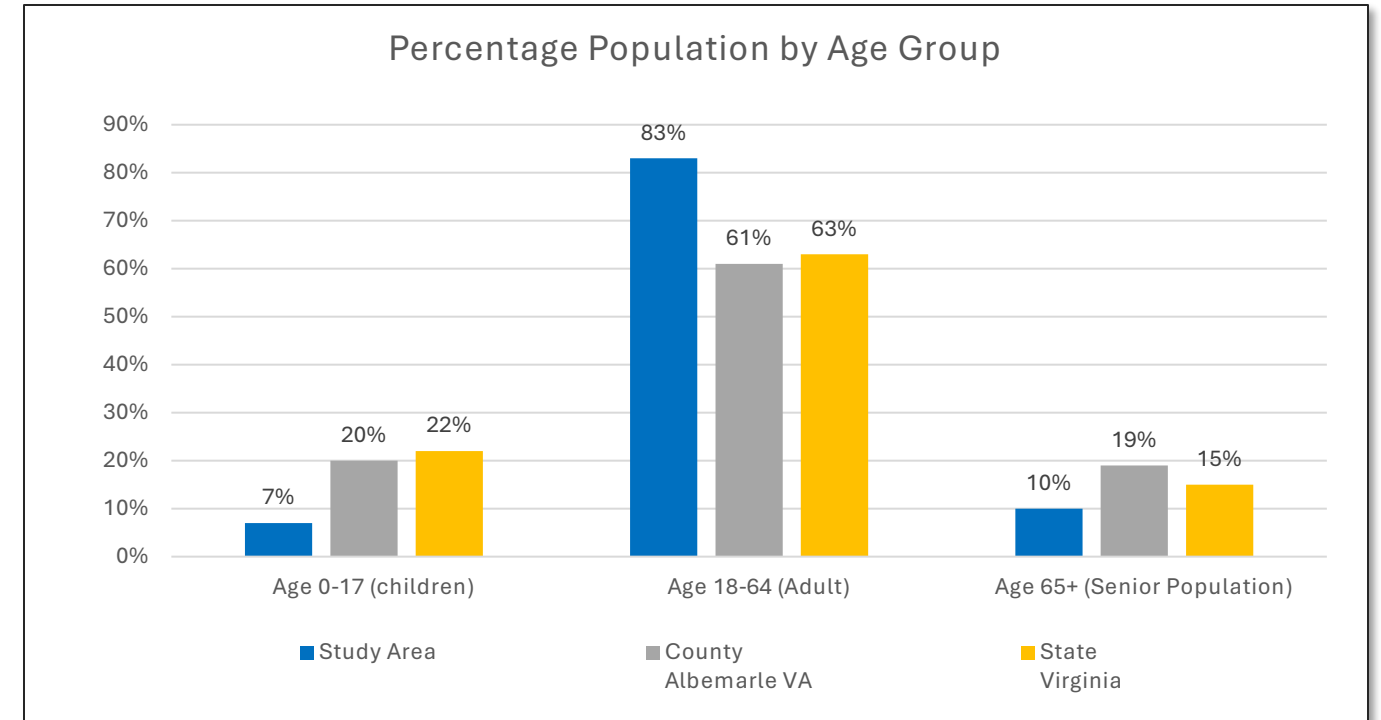


Figure 1-5. STEAP Tool Analysis Population by Age Group

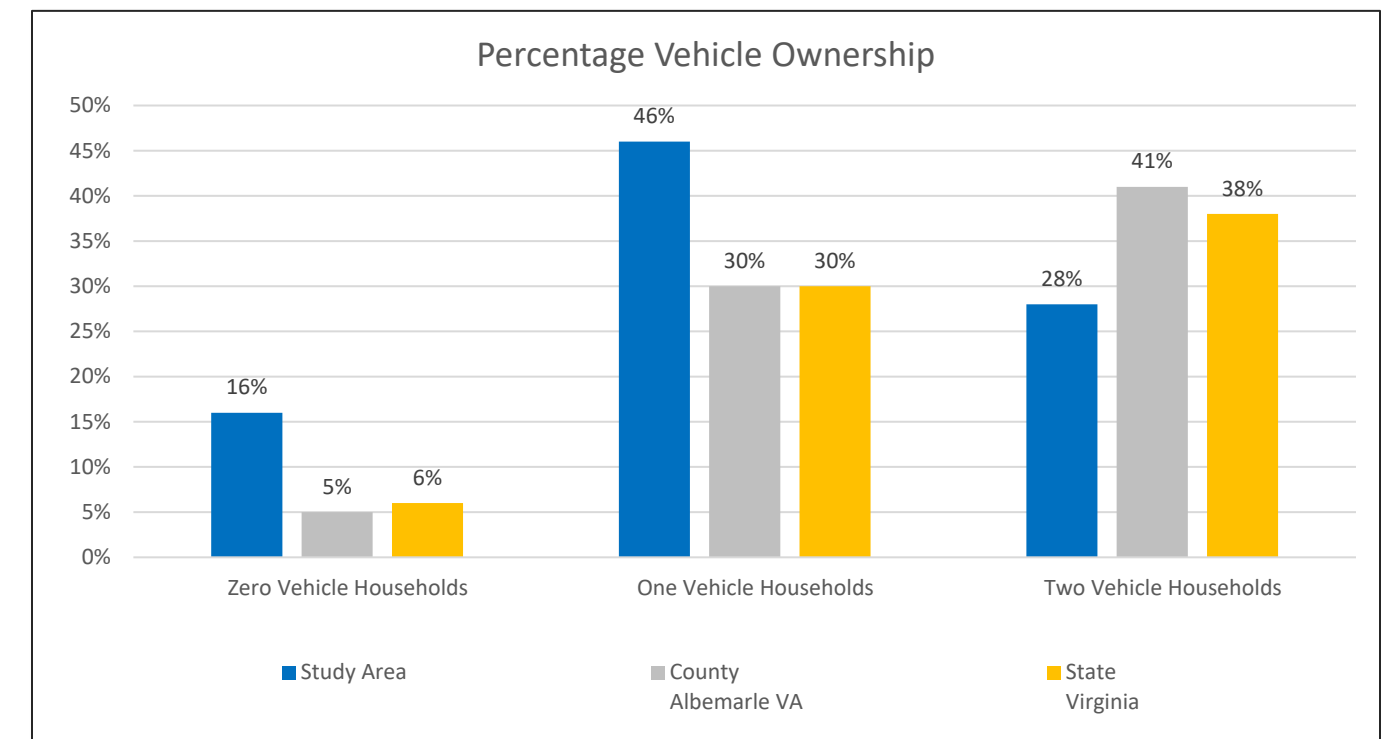


Figure 1-6. STEAP Tool Analysis Vehicle Ownership

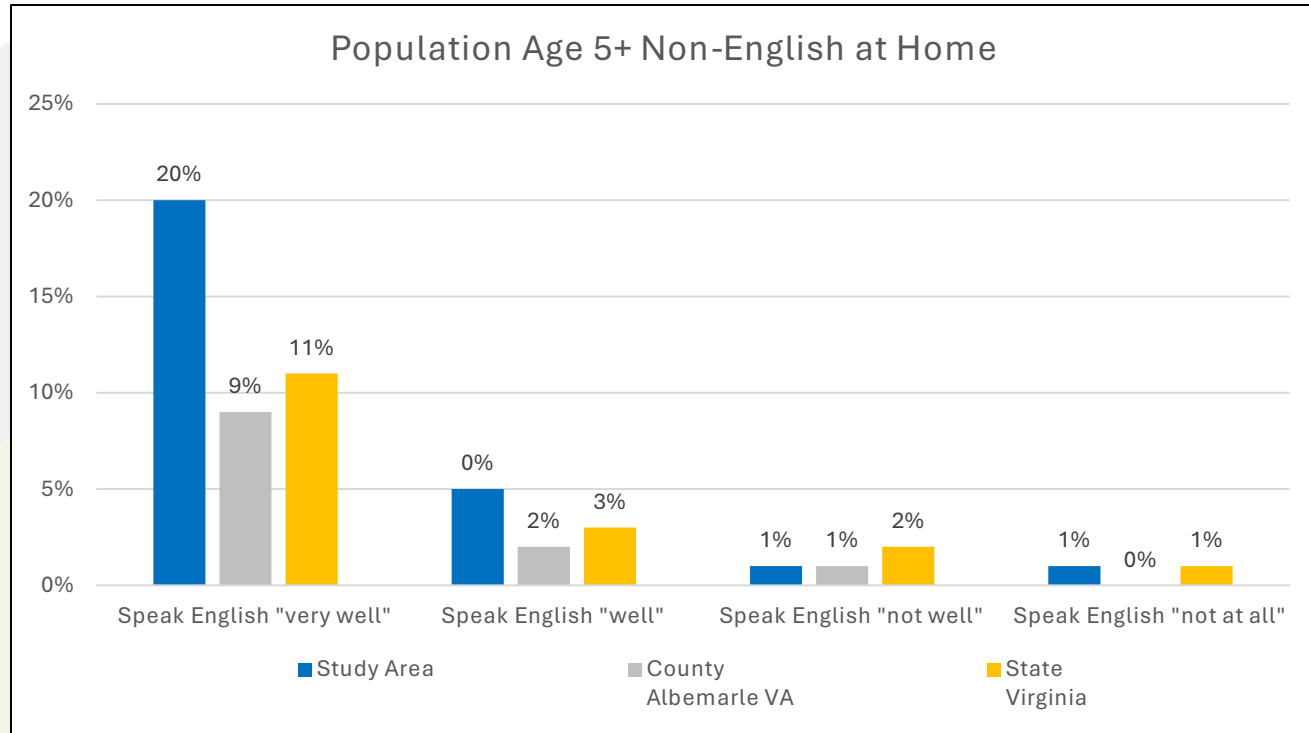


Figure 1-7. STEAP Tool Analysis Non-English at Home

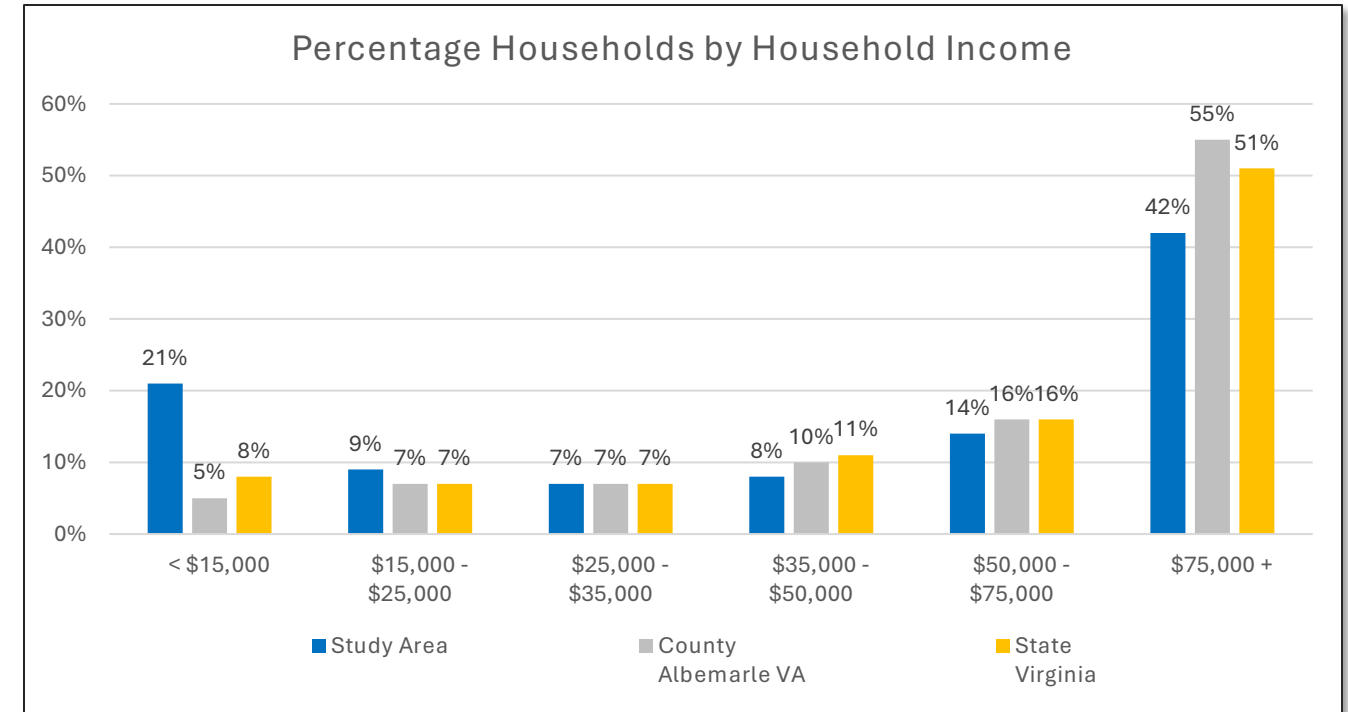


Figure 1-9. STEAP Tool Analysis Household Income

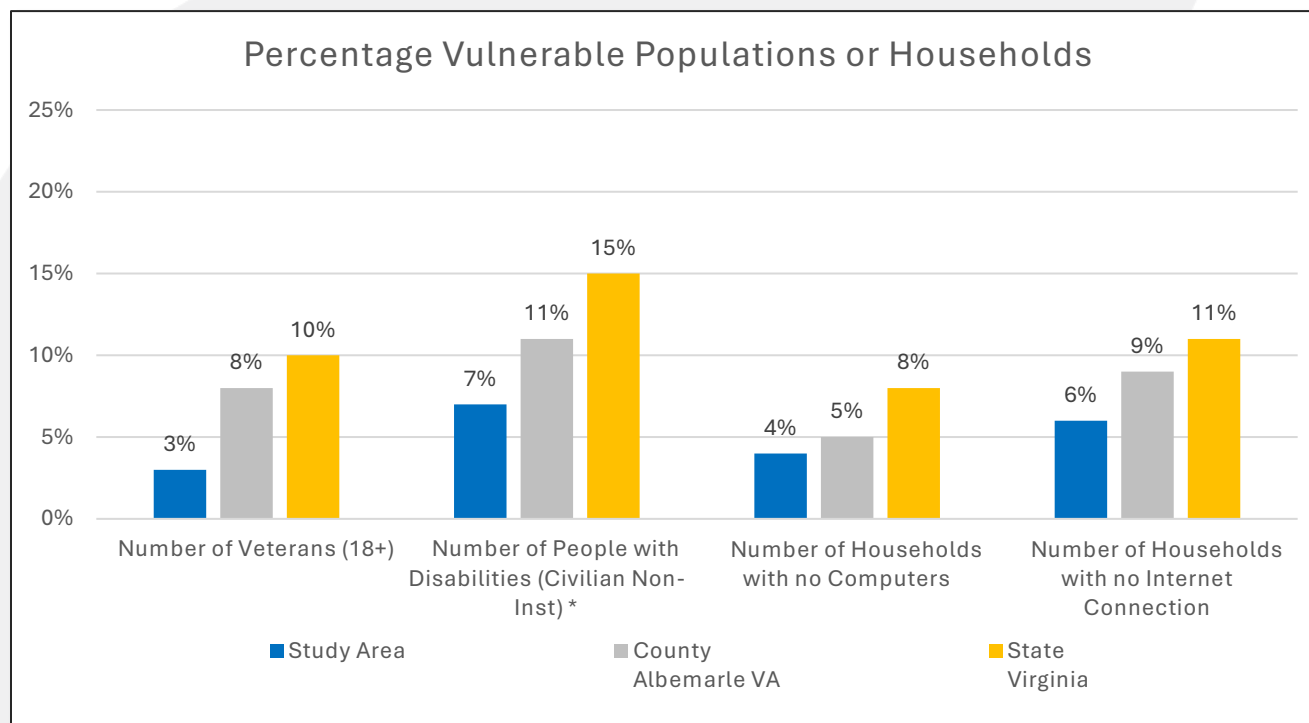


Figure 1-8. STEAP Tool Analysis Vulnerable Populations

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 Ivy Road corridor are presented in **Table 1-3**. Bicycle access and capacity preservation are categorized as medium priority needs. Congestion mitigation is categorized as a high priority need. Transit access, transit access for equity emphasis areas, and transportation demand management are categorized as very high priority needs.

Table 1-3. Ivy Road Corridor – VTrans Needs

VTRANS IDENTIFIED NEEDS	PRIORITIES
Bicycle Access	Medium
Capacity Preservation	Medium
Congestion Mitigation	High
IEDA (UDA) Access	None
Pedestrian Access	Select
Safety Improvement	Select
Pedestrian Safety Improvement	None
Reliability	None
Rail On-time Performance	None
Transit Access	Very High
Transit Access for Equity Emphasis Areas	Very High
Transportation Demand Management	Very 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** presents an overview map of the study area with the 2019 VTrans project overview for Ivy Road from Ednam Drive to Alderman Road/Copeley Road.

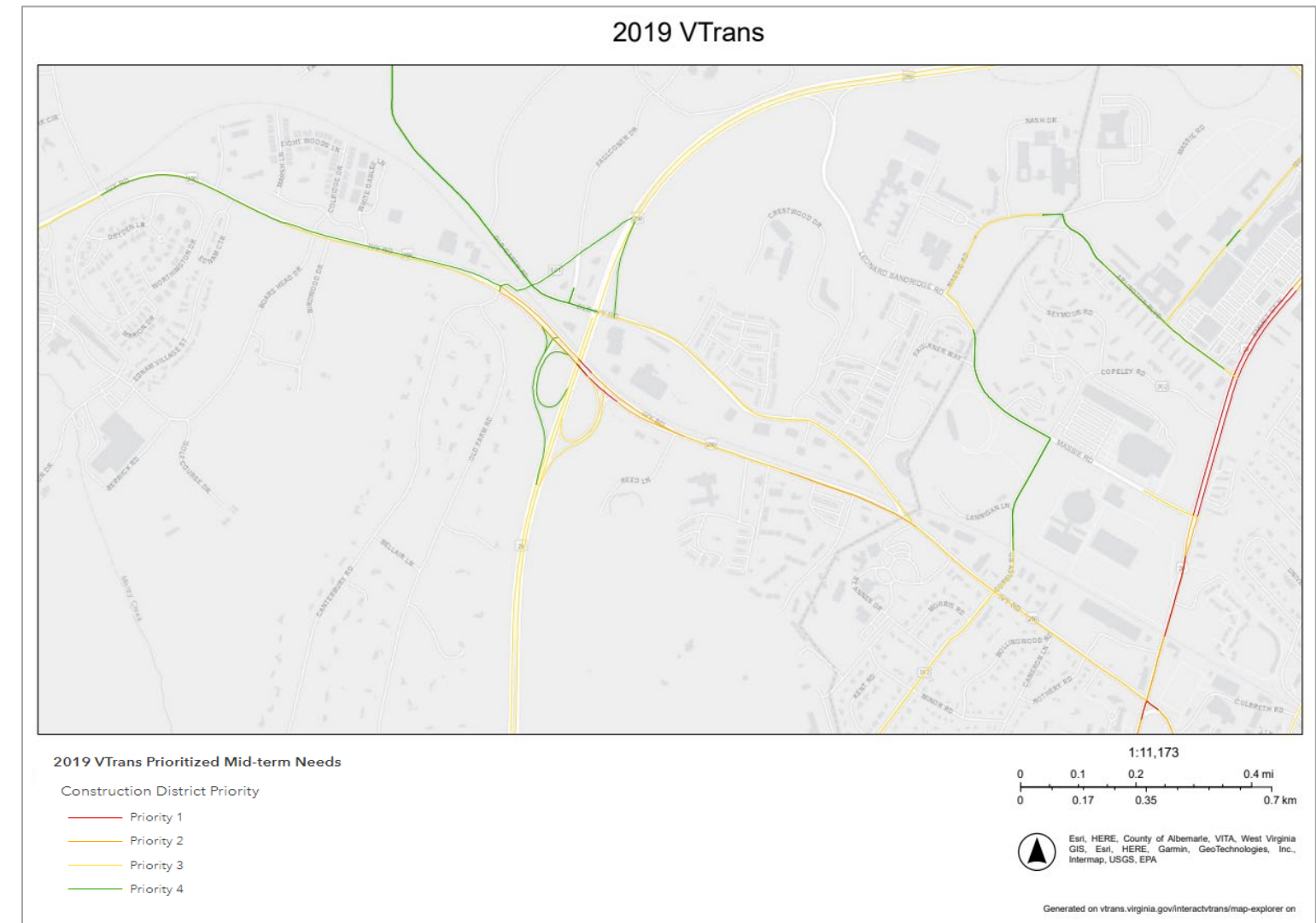


Figure 1-10. 2019 VTrans Prioritized Mid-term Needs in the Study Area

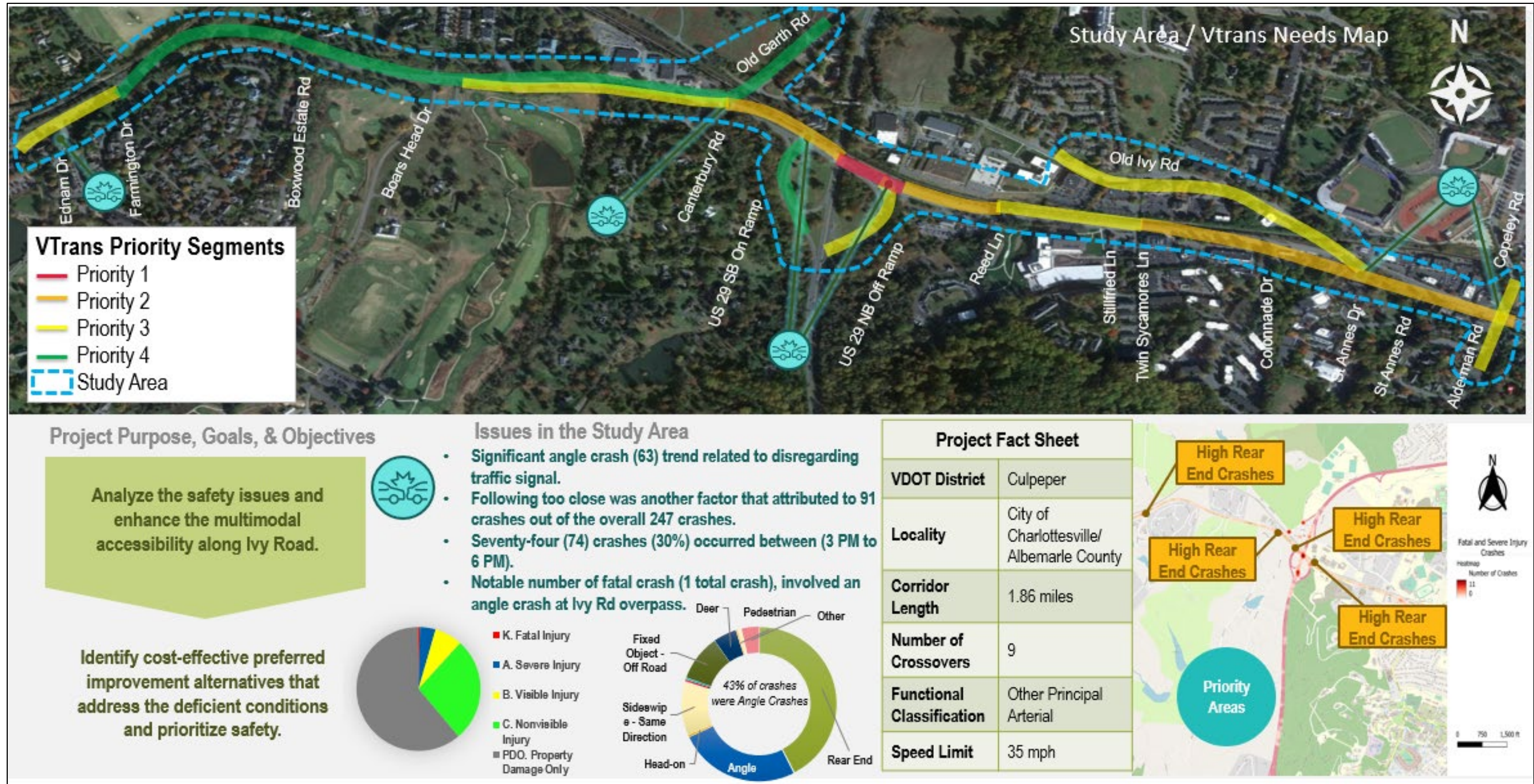


Figure 1-11. Project Overview for Ivy Road from Ednam Drive to Alderman Road/Copeley Road

Existing Conditions

Existing conditions evaluations were performed for the Ivy Road corridor in the City of Charlottesville and 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, two hundred and forty-seven (247) crashes were reported in the study area, of which one-hundred and fifteen (115) occurred at or within 150 feet of an intersection, including intersections at the end of ramps. A summary of the Ivy Road 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 reports are provided in **Appendix B**.

- The reported crash history includes one hundred and fifty-one (151) Property Damage Only (PDO) related crashes and ninety-six (96) injury crashes. Among these ninety-six (96) injuries crashes, ten (10) crashes were severe injury, eighteen (18) were visible injury, and one (1) crash was fatal.
- The reported fatal collision that occurred in October 2022 took place on Route 29 just south of the Ivy Road Bypass. This crash involved wet pavement conditions. The angle crash happened when the northbound vehicle on Route 29 hydroplaned due to standing water in the roadway and crossed over the center concrete median into the southbound lanes. The southbound vehicle struck the northbound vehicle on the passenger side. The operator of the northbound vehicle had both drugs and alcohol in his system and was not restrained. The northbound driver suffered a fatal injury. The driver of the southbound vehicle was restrained but still had severe injuries.
- The reported crashes include sixty-three (63) angle crashes, constituting (26%) of the total crashes, one-hundred and five (105) rear-end crashes making up (43%), and twenty-eight (28) side swipe – same direction crashes accounting for (11%) of the crashes.
- During the study period, two-hundred and forty-seven (247) crashes were reported in the study area, of which one-hundred and fifteen (115) crashes (47%) occurred at or within 150

feet of an intersection. Below is a breakdown of crashes along the Ivy Road corridor and each of the corresponding side street approaches:

- Ednam Drive (Signalized) – 11 (4%)
- Farmington Drive (Signalized) – 3 (1%)
- Boxwood Estate Road (Stop Controlled) – 3 (1%)
- Ednam Center (Stop Controlled) – 2 (1%)
- Colridge Drive/Boar’s Head Drive (Stop Controlled) – 3 (1%)
- Birdwood Drive (Stop Controlled) – 3 (1%)
- White Gables Lane (Stop Controlled) – 3 (1%)
- Canterbury Road/Old Garth Road (Signalized) – 21 (9%)
- US 29 Southbound Ramps (Signalized) – 12 (5%)
- US 29 Northbound Ramps (Signalized) – 10 (4%)
- Reed Lane (Stop Controlled) – 5 (2%)
- Stillfried Lane (Stop Controlled) – 3 (1%)
- Twin Sycamores Lane (Stop Controlled) – 4 (2%)
- Colonnade Drive (Stop Controlled) – 3 (1%)
- Old Ivy Road/St Annes Drive (Signalized) – 10 (4%)
- St Annes Drive (Stop Controlled) – 7 (3%)
- Alderman Road (Signalized) – 12 (5%)

- “Following too close” and “did not have right of way” each attributed to forty-five (45) crashes, accounting for (18%) of the total crashes. “Disregarded traffic signal” also contributed to eleven (11) crashes, accounting for (5%) of the total crashes.
- Ninety (90) crashes, constituting (36%) of the total incidents during the midday non-peak periods (between 9 AM to 3 PM), while forty-four (44) crashes, accounting (20%) and seven-four (74) crashes, accounting (30%) occurred during the typical AM (6 AM to 9 AM) and PM (3 PM to 6 PM) peak periods, respectively.
- Twenty (20) crashes occurred during this AM peak hour, accounting for (8%) of the total crashes (7:45 AM to 8:45 AM). Nine (9) crashes occurred during the PM peak hour, representing (4%) of the crashes (4:15 PM to 5:15 PM).
- Speeding, while not a dominant factor, was still involved in 31 out of 247 crashes, accounting for 13% of the incidents. While this percentage may seem relatively low, it’s essential to recognize that even a small increase in speed can significantly impact crash severity.
- The reported crashes include eleven (11) crashes involving drivers under the influence, representing (4%) of the total crashes involved.
- Fifty-two (52) crashes, accounting for (21%) occurred during wet weather conditions, including the fatal crash.
- From 2018-2022, fifty-four (54) crashes, accounting for (22%) involved young drivers, while fifty-five (55) crashes (22%) 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 (57) occurring in 2018 and 2022, followed by 52 in 2019.
2. The approximate average number of reported crashes per year is 49.
3. The plurality of reported crashes within the corridor are rear end crashes. These constitute approximately (43%) of the total crashes.
4. A total of 95 crashes were associated with injuries, accounting for approximately (38%) of the reported crashes within the corridor. There was one crash that resulted in a fatality. The fatal crash occurred in October 2022; it took place on Route 29 just south of the Ivy Road Bypass. This crash involved wet pavement conditions. The angled crash happened when the northbound vehicle on Route 29 hydroplaned due to standing water in the roadway and crossed over the center concrete median into the southbound lanes. The southbound vehicle struck the northbound vehicle on the passenger side. The operator of the northbound vehicle had both drugs and alcohol in his system and was not restrained. This driver suffered a fatal injury. The driver of the southbound vehicle was restrained but still had severe injuries.
5. A total of 44 crashes occurred during the night, accounting for (17%) of the total crashes.
6. Speeding, while not a dominant factor, was still involved in 31 out of 247 crashes, accounting for 13% of the incidents.
7. A senior driver was involved in 55 crashes, accounting for (22%) of the total crashes.
8. A leading cause of crashes was distracted driving. Forty-five (45) crashes, representing (18%) involved distracted drivers.

Table 1-4. Ivy Road – Crash Summary

US 250 & US 29 Corridor Crashes		Number of Crashes Per Year					5 Year Total Crashes	Average Crashes Per Year	%
		2018	2019	2020	2021	2022			
CRASH TYPE	1. Rear End	32	26	16	15	16	105	21	43%
	2. Angle	11	12	7	11	22	63	12.6	26%
	3. Head-on	0	0	1	0	0	1	0.2	0.5%
	4. Sideswipe - Same Direction	4	5	4	4	11	28	5.6	11%
	5. Sideswipe - Opposite Direction	0	0	1	0	0	1	0.2	0.5%
	9. Fixed Object - Off Road	7	3	8	2	4	24	4.8	10%
	10. Deer	1	4	4	2	1	12	2.4	5%
	12. Pedestrian	0	0	1	0	0	1	0.2	0.5%
	16. Other	2	2	4	1	3	12	2.0	4%
	Total	57	52	46	35	57	247	49.4	-
SEVERITY	K. Fatal Injury	0	0	0	0	1	1	0.2	0.5%
	A. Severe Injury	1	3	3	1	2	10	2	4%
	B. Visible Injury	3	4	4	1	6	18	3.6	7%
	C. Nonvisible Injury	8	13	13	9	24	67	13.4	27%
	PDO. Property Damage Only	45	32	26	24	24	151	30.2	61%
KAB	4	7	7	2	9	29	5.8	12%	
LIGHTING CONDITIONS	1. Dawn	2	0	2	0	1	5	1	2%
	2. Daylight	43	44	30	31	50	198	39.6	80%
	3. Dusk	3	0	1	0	0	4	0.8	2%
	4. Darkness - Road Lighted	1	1	4	1	2	9	1.8	4%
	5. Darkness - Road Not Lighted	8	7	8	3	4	30	6	12%
	7. Unknown	0	0	1	0	0	1	0.2	0.5%
SURFACE CONDITIONS	1. Dry	39	45	32	30	47	193	38.6	78%
	2. Wet	17	7	13	5	10	52	10.4	21%
	4. Icy	1	0	0	0	0	1	0.2	0.5%
	10. Slush	0	0	1	0	0	1	0.2	0.5%
TIME OF DAY	0 - 3 AM	1	1	2	0	0	4	0.8	2%
	3 - 6 AM	0	1	3	0	1	5	1	2%
	6 - 9 AM	6	12	6	9	11	44	8.8	18%
	9 AM - 12 PM	11	10	4	8	12	45	9	18%
	12 - 3 PM	11	7	8	7	12	45	9	18%
	3 - 6 PM	17	17	16	8	16	74	14.8	30%
	6 - 9 PM	8	2	4	3	1	18	3.6	7%
9 PM - 12 AM	3	2	3	0	4	12	2.4	5%	
SPEED FACTOR	Speeding	5	2	8	3	13	31	6.2	13%
	Not Speeding	52	50	38	32	44	216	43.2	87%
DRIVER AGE	Young Driver (<21)	13	10	4	11	16	54	10.8	22%
	Senior Driver (>65)	10	12	10	7	16	55	11	22%

Figure 1-12. Ivy Road – 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 period and 4:00 to 5:30 in the PM peak period. The following observations were noted for the corridor:

- Ivy Road at Ednam Drive
 - Lane Configuration: T-intersection. There is no intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - NBR sight distance looks adequate, but a combination of horizontal curve and steep slope east of the intersection along Ivy Road limits sight distance.
 - Pedestrian Activity / Amenities: No sidewalk on either side.
- Ivy Road at Farmington Drive
 - Lane Configuration: One through lane with a left turn lane for the EB and WB approach. There is no intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - Pedestrian Activity / Amenities: No sidewalk on either side of Ivy Road.
- Ivy Road at Boxwood Estate Rd
 - Lane Configuration: One through and right turn lane on EB with left for the EB and one through lane WB approach. There is no intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
- Ivy Road at Colridge Drive
 - Lane Configuration: One through and right turn lane on EB with a two-way left turn lane for the EB and WB approaches, and one through lane on the WB approach and a WB right turn lane. There is no intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - Pedestrian Activity / Amenities: No sidewalk on either side.
- Ivy Road at Old Garth
 - Lane Configuration: On the eastbound approach, there is one through lane, one left lane, and one right lane; on the westbound approach, there is a left turn lane and a shared through-right turn lane.
 - EBL queue spillback to Bellair Place entrance.
 - The existing sidewalk goes WB and ends with very steep uphill grade that leads to nowhere.
 - Pedestrian Activity / Amenities: Crosswalk markings and pedestrian signal heads are only on the west leg. A pair of joggers and a cyclist were noted going EB along Ivy.
- Ivy Road at US 29 SB Ramp
 - Lane Configuration: NB & SB ramp phases are actuated coordinated.
 - Ivy Road, through movements at the two ramp intersections, runs concurrently.
 - Pedestrian Activity / Amenities: No crosswalk markings. Ruts in gravel shoulder show evidence of vehicles using the shoulder to get around queued traffic.
- Ivy Road at US 29 NB Ramp

- Signal Timing: NB & SB ramp phases are actuated coordinated.
- NBL vehicles' queue blocks NBR from reaching the channelized turn lane; it is slightly too narrow.
- Pedestrian Activity / Amenities: No pedestrian crosswalks. 2 cyclists were noted on Ivy EB.
- Ivy Road at Stillfried Ln
 - Lane Configuration: T-intersection. There is no intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - Pedestrian Activity / Amenities: Sidewalk only on the south side of Ivy Road.
- Ivy Road at Colonnade Drive
 - Lane Configuration: T-intersection. There is no intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - Pedestrian Activity / Amenities: Sidewalk only on the south side of Ivy Road.
- Ivy Road at Old Ivy Road
 - Lane Configuration: skewed 4-way intersection. There is side street intersection lighting, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - APS pushbuttons installed.
 - Pedestrian Activity / Amenities: Sidewalk on both sides of the Ivy Road.
- Ivy Road at Alderman Road
 - Lane Configuration: 4-way intersection with exclusive left turn lanes. There is intersection lighting at the intersection, and the speed limit on Ivy Road through this intersection is 35 MPH.
 - EB queue extended to the upstream intersection.
 - EBR vehicles were skipping the queue by driving through the bike lane and parking buffer.
 - Pedestrian Activity / Amenities: 4 pedestrian crossings, all with high visibility markings. APS pushbuttons installed.

c) Data Collection and Traffic Operations Analysis

The traffic data for the study area was obtained from turning movement counts collected on Thursday, June 1, 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** through **Figure 1-16** present the peak hour volume diagrams for the Existing Conditions 2023, and are 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 operate on demand during 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 in **Table 1-5** through **Table 1-6**. Overall, the Ivy Road corridor capacity results vary for the signalized intersections. The signalized intersection's overall intersection level of service (LOS) ranges from B to C. However, many unsignalized intersection approaches operate with poor levels of service on the side street, mostly the left-turn movements. Existing condition traffic analysis results are provided in **Table 1-7** through **Table 1-8**, and details are provided in **Appendix E**. All the unsignalized turning movements to and from the side streets are low to moderate (10 to 150 vph).

Figure 1-13. Ivy Road – Existing Conditions Peak Hour Volumes (1 of 4)

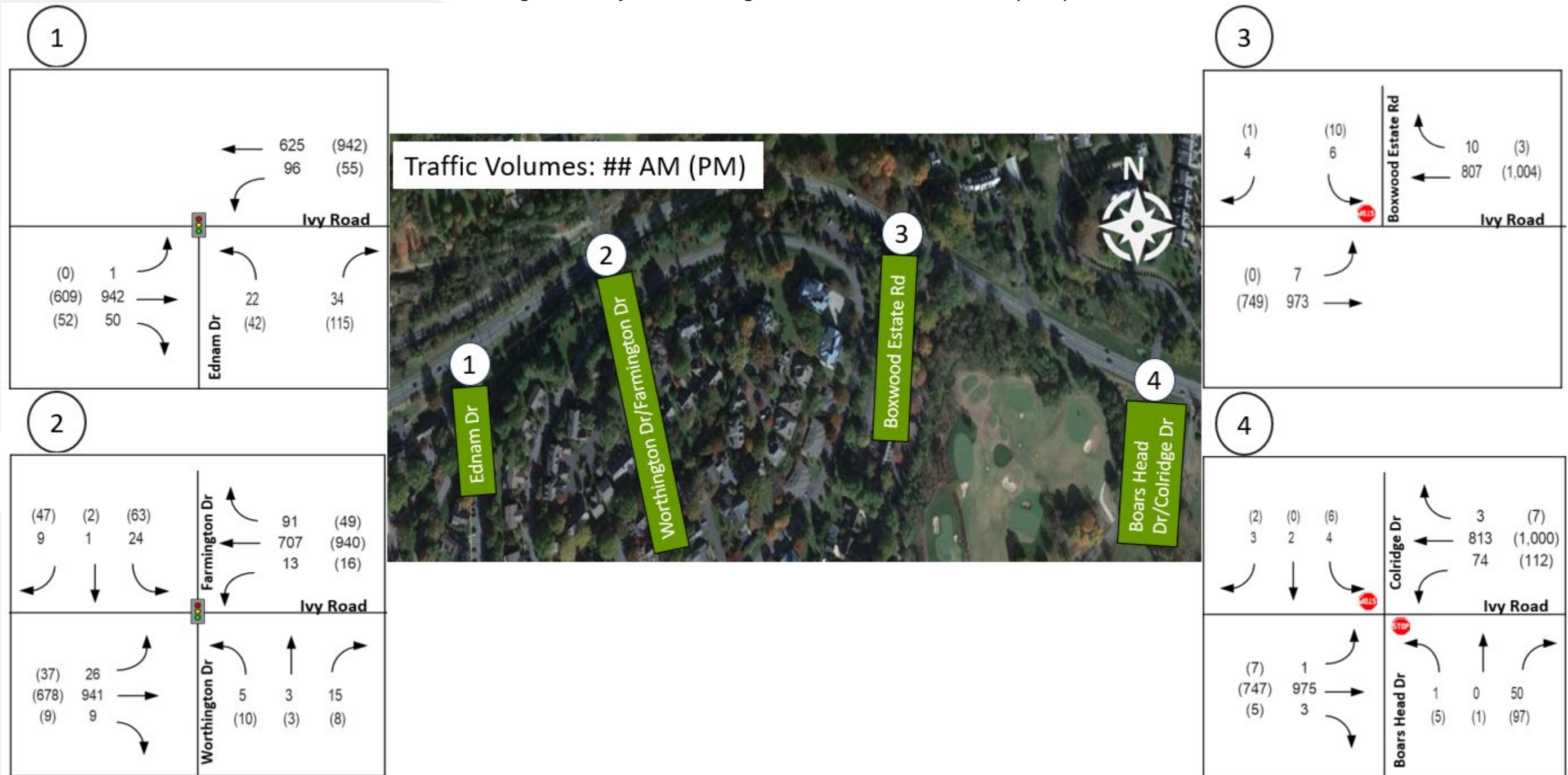


Figure 1-14. Ivy Road – Existing Conditions Peak Hour Volumes (2 of 4)

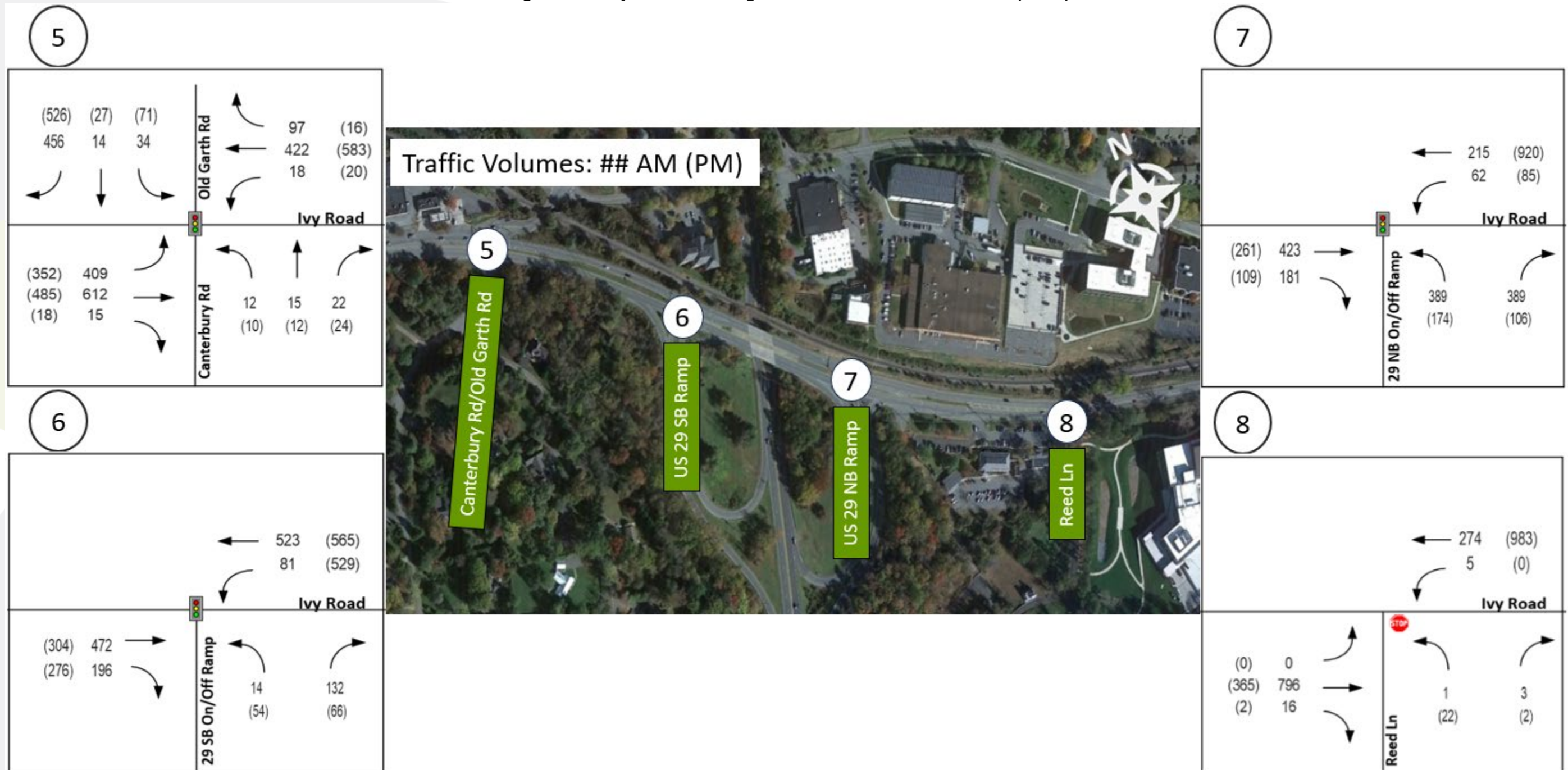


Figure 1-15. Ivy Road – Existing Conditions Peak Hour Volumes (3 of 4)

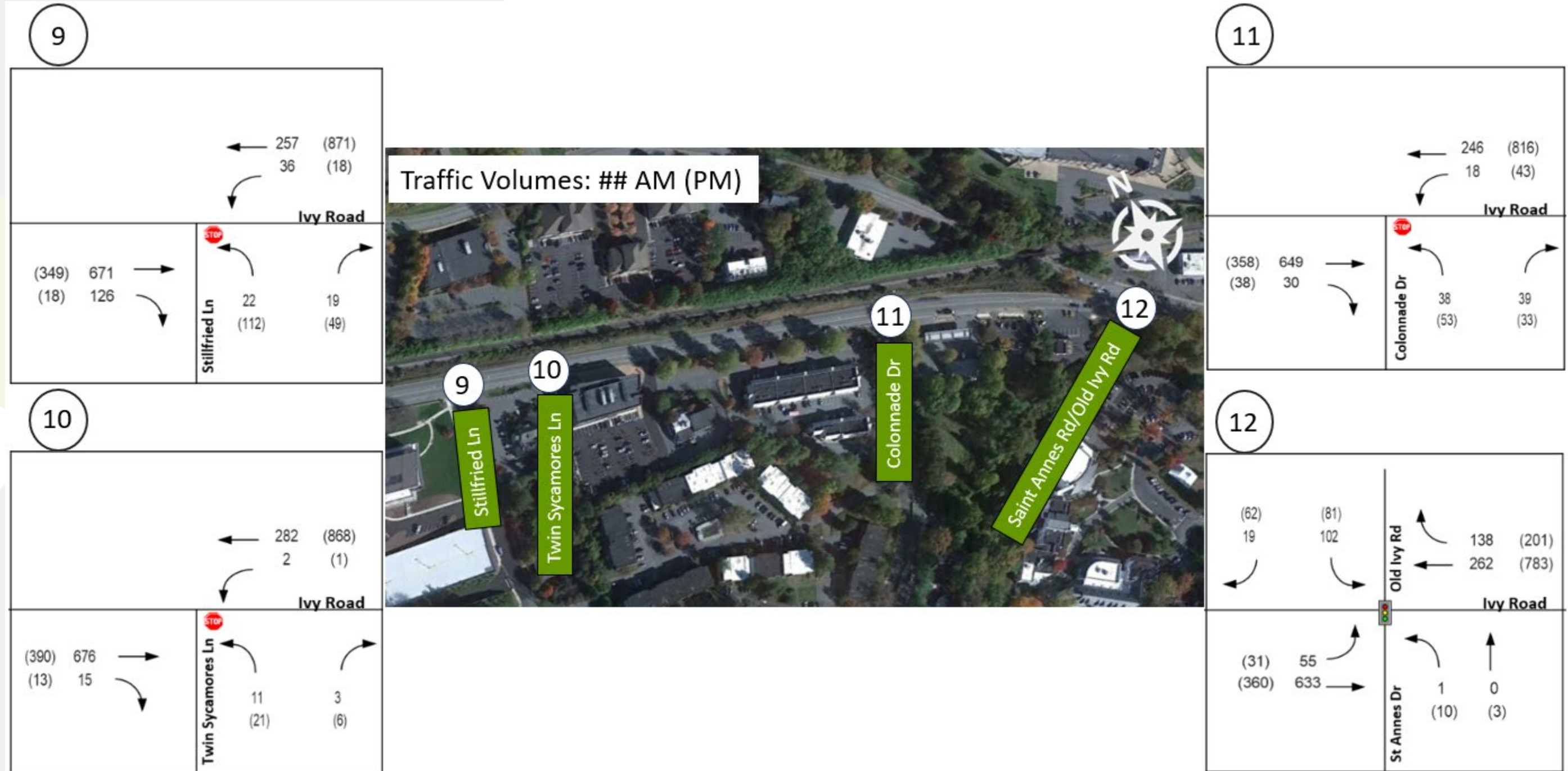


Figure 1-16. Ivy Road – Existing Conditions Peak Hour Volumes (4 of 4)



Table 1-5. Ivy Road – Existing Conditions Intersection Analysis Results (1 of 4)

No.	Intersection	Approach	Lane Group	HCM EC 2023 Delay (sec/vgh)		EC 2023 HCM LOS		Sim Traffic EC 2023 Delay (sec/vgh)		EC 2023 SIM Traffic LOS		EC 2023 95th % (ft.)		EC 2023 Queue Max (ft.)		Storage (ft.)
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
1	Ivy Rd at Ednam Dr -Signalized-	EB	EBL/T	16.2	10.4	B	B	6.7	7.2	A	A	691	315	347	268	
			EBR	5.5	6.2	A	A	3.8	5.2	A	A	12	14	75	69	355
		WB	WBL	24.5	5.6	C	A	18.7	11.7	B	B	21	m14	111	88	180
			WBT	1.9	6.3	A	A	3.9	8.5	A	A	38	214	126	316	
		NB	NBL	55.0	48.4	E	D	76.3	42.8	E	D	46	65	88	191	
			NBR	53.8	47.2	D	D	84.8	45.0	F	D	35	56	107	119	120
Overall				12.5	11.2	B	B	8.8	11.5	A	B					
2	Ivy Rd at Farmington Dr -Signalized-	EB	EBL	1.6	23.0	A	C	12.0	19.8	B	B	m1	m18	75	118	160
			EBR	5.4	6.9	A	A	2.2	3.4	A	A	m0	m0	18	23	
			EBT	6.6	15.4	A	B	6.1	9.8	A	A	#963	515	338	311	
		WB	WBL	27.5	10.9	C	B	21.3	10.5	C	B	m5	15	38	26	350
			WBR	6.0	8.1	A	A	4.3	5.6	A	A	m47	32	88	84	220
			WBT	13.9	23.3	B	C	5.7	8.7	A	A	622	#883	256	331	
		NB	NBL/T	57.8	58.0	E	E	48.4	49.2	D	D	23	29	46	51	
			NBR	56.5	52.7	E	D	48.8	46.6	D	D	0	0	59	39	
		SB	SBL/T	58.9	57.3	E	E	55.0	52.5	E	D	54	#144	97	168	
			SBR	58.9	57.3	E	E	17.8	27.0	B	C	54	#144	97	168	
Overall				11.0	22.2	B	C	7.4	12.1	A	B					
3	Ivy Rd at Canterbury Rd -Signalized-	EB	EBL	18.1	16.3	B	B	33.1	26.7	C	C	306.0	176.0	190	190	190
			EBR	7.1	7.6	A	A	10.8	7.5	B	A	m0	0.0	31	27	440
			EBT	19.8	11.4	B	B	17.1	12.2	B	B	635	298	635	396	
		WB	WBL	11.9	13.9	B	B	21.1	16.0	C	B	m11	m13	190	16	205
			WBR/T	16.9	24.6	B	C	34.2	24.0	C	C	#555	#348	535	450	
		NB	NBL/T	56.9	58.6	E	E	58.1	59.1	E	E	53	45	90	68	
			NBR	55.0	56.2	E	E	59.3	55.4	E	E	0	0	87	74	150
		SB	SBL/T	59.5	75.3	E	E	262.6	573.0	F	F	80	#166	1228	1268	
SBR	40.8		52.7	D	D	214.3	547.9	F	F	112	226	71	30	30		
Overall				24.8	29.8	C	C	72.4	117.1	E	F					
4	Ivy Rd at US 29 SB Ramp -Signalized-	EB	EBR	0.7	8.4	A	A	5.7	10.7	A	B	0	11	52	73	115
			EBT	2.8	17.3	A	B	4.6	20.8	A	C	24	77	91	115	
			WBL	76.7	41.9	E	D	60.9	47.8	E	D	113	391	169	516	
		WB	WBT	1.6	3.7	A	A	1.7	5.2	A	A	40	210	62	232	
			NBL	54.0	57.3	D	E	73.9	33.8	E	C	33	86	75	131	
			NBR	53.3	52.7	D	D	2.4	2.8	A	A	57	45	16	2	225
Overall				11.5	21.4	B	C	7.3	23.0	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 1-6. Ivy Road – Existing Conditions Intersection Analysis Results (2 of 4)

No.	Intersection	Approach	Lane Group	HCM EC 2023 Delay (sec/veh)		EC 2023 HCM LOS		Sim Traffic EC 2023 Delay (sec/veh)		EC 2023 SIM Traffic LOS		EC 2023 95th % (ft.)		EC 2023 Queue Max (ft.)		Storage (ft.)
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
5	Ivy Rd at US 29 NB Ramp -Signalized-	EB	EBR	38.7	6.3	D	A	5.8	6.4	A	A	75	21	56	5	165
			EBT	20.2	7.5	C	A	24.1	10.3	C	B	219	45	299	138	
		WB	WBL	14.3	5.0	B	A	23.5	9.8	C	A	58	41	95	138	
			WBT	14.0	6.7	B	A	16.6	6.6	B	A	82	210	190	226	
		NB	NBL	42.0	54.6	D	D	52.5	46.6	D	D	340	203	888	289	
			NBR	33.2	43.4	C	D	33.8	6.7	C	A	167	48	100	96	
Overall				29.4	14.1	C	B	30.0	11.6	C	B					
6	Ivy Rd at Old Ivy Rd/St Annes Dr -Signalized-	EB	EBL	7.3	0.0	A	A	21.1	30.5	C	C	33	24	79	44	90
			EBT	11.2	6.7	B	A	6.4	5.2	A	A	325	161	184	114	
		WB	WBR	7.6	0.0	A	A	7.1	5.5	A	A	67	95	108	107	
			WBT	8.2	10.8	A	B	4.3	7.7	A	A	119	508	128	298	
		NB	NBL/R/T	28.9	56.7	C	E	43.6	33.9	D	C	5	27	25	80	
		SB	SBL/R/T	22.8	31.5	C	C	15.7	27.3	B	C	69	94	57	80	
Overall				11.1	12.1	B	B	7.4	8.9	A	A					
7	Ivy Rd at Alderman Rd/Copeley Rd -Signalized-	EB	EBL	7.8	0.0	A	A	11.0	13.6	B	B	45	240	176	84	240
			EBR	11.4	0.0	B	A	10.1	6.6	B	A	33	240	195	60	
			EBT	17.5	13.5	B	B	14.0	10.3	B	B	317	0	318	177	
		WB	WBL	12.0	0.0	B	A	12.7	13.1	B	B	26	320	59	73	320
			WBR/T	14.6	21.7	B	C	4.9	7.4	A	A	75	0	120	202	
			WBT	14.6	21.7	B	C	10.9	18.2	B	B	75	0	113	267	
		NB	NBL	17.1	0.0	B	A	17.4	18.6	B	B	64	120	107	115	120
			NBR/T	16.8	15.0	B	B	20.6	10.2	C	B	62	0	126	144	
		SB	SBL	24.8	0.0	C	A	22.0	23.4	C	C	39	250	71	81	250
			SBR/T	26.0	24.4	C	C	8.5	10.2	A	B	102	0	126	163	
Overall				16.6	19.0	B	B	13.0	14.9	B	B					
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 1-7. Ivy Road – Existing Conditions Intersection Analysis Results (3 of 4)

No.	Intersection	Approach	Lane Group	HCM EC 2023 Delay (sec/veh)		EC 2023 HCM LOS		Sim Traffic EC 2023 Delay (sec/veh)		EC 2023 SIM Traffic LOS		EC 2023 95th % (ft.)		EC 2023 Queue Max (ft.)		Storage (ft.)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM		
8	Ivy Rd at Boxwood Estate Rd -Unsignalized-	EB	EBL	0.0	0.0	A	A	6.1	0.0	A	A	0	0	29	6	300	
			EBT	0.0	0.0	A	A	1.8	2.0	A	A	0	0	20	9		
		WB	WBR/T	0.0	0.0	A	A	1.8	1.9	A	A	0	0	0	0		
			SBL/R	250.4	32.6	F	D	26.8	16.8	D	C	25	8	31	38		
9	Ivy Rd at Boars Head Dr/Colridge Dr -Unsignalized-	EB	EBL	10.8	14.5	B	B	2.7	6.1	A	A	0	3	6	29	50	
			EBR	0.0	0.0	A	A	2.1	1.6	A	A	0	3	0	5		275
			EBT	0.0	0.1	A	A	2.8	2.6	A	A	0	3	2	0		
		WB	WBL	0.0	0.0	A	A	14.0	11.7	B	B	0	0	49	49	50	
			WBR	0.0	0.0	A	A	3.8	4.7	A	A	0	0	0	0		270
			WBT	0.0	0.0	A	A	4.7	6.0	A	A	0	0	204	132		
			NB	NBL/R/T	22.6	26.5	C	D	43.0	37.1	E	E	20	45	69		107
SB	SBL/R/T	13.9	159.9	B	F	43.4	41.4	E	E	3	23	39	54				
10	Ivy Rd at Reed Ln -Unsignalized-	EB	EBL/T	0.0	0.0	A	A	0.7	0.3	A	A	0	0	67	0	50	
			EBR	0.0	0.0	A	A	0.6	0.5	A	A	0	0	67	21		
		WB	WBL	9.6	0.0	A	A	6.0	1.3	A	A	0	0	27	0		
			WBT	0.1	0.0	A	A	0.6	1.3	A	A	0	0	0	0		
NB	NBL/R	16.8	32.6	C	D	10.7	3.5	B	A	0	15	27	46				
11	Ivy Rd at Stillfried Ln -Unsignalized-	EB	EBL/T	0.0	0.0	A	A	1.2	0.8	A	A	0	0	0	0	180	
			EBR	0.0	0.0	A	A	1.0	0.4	A	A	0	0	24	2		
		WB	WBL	0.0	0.0	A	A	6.3	3.3	A	A	0	0	55	33		
			WBT	0.0	0.0	A	A	0.2	0.5	A	A	0	0	0	0		
		NB	NBL	21.1	65.7	C	F	15.0	33.8	B	D	8	108	47	201		
NBR	17.6	49.0	C	E	6.0	11.4	A	B	8	108	48	66	65				

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

*HCM 6th Ed Methodology

Table 1-8. Ivy Road – Existing Conditions Intersection Analysis Results (4 of 4)

No.	Intersection	Approach	Lane Group	HCM EC 2023 Delay (sec/veh)		EC 2023 HCM LOS		Sim Traffic EC 2023 Delay (sec/veh)		EC 2023 SIM Traffic LOS		EC 2023 95th % (ft.)		EC 2023 Queue Max (ft.)		Storage (ft.)
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
12	Ivy Rd at Twin Sycamores Ln -TWSC-	EB	EBL/R/T	0.0	0.0	A	A	0.4	0.4	A	A	0	0	0	0	
		WB	WBL	9.2	8.2	A	A	3.1	1.6	A	A	0	0	6	6	
			WBT	0.0	0.0	A	A	0.4	0.9	A	A	0	0	0	0	
		NB	NBL/R	19.3	25.9	C	D	16.1	4.8	C	A	5	13	41	60	
13	Ivy Rd at Colonnade Dr -TWSC-	EB	EBL/T	0	0	A	A	0.7	0.4	A	A	0	0	0	0	
			EBR	0	0	A	A	0.2	0.2	A	A	0	0	0	4	360
		WB	WBL	9.2	8.3	A	A	6.0	5.0	A	A	3	3	40	44	375
			WBT	0.6	0.4	A	A	1.3	2.2	A	A	0	0	0	0	
		NB	NBL/R	19.8	37	C	E	14.0	22.1	B	C	25	58	89	106	
14	Ivy Rd at Saint Annes Rd -TWSC-	EB	EBL/R/T	0	0	A	A	3	2	A	A	0	0	2	0	
		WB	WBL	9	8	A	A	9	6	A	A	0	0	30	24	15
			WBT	0	0	A	A	2	3	A	A	0	0	44	26	
		NB	NBL/R	15	13	B	B	14	18	B	C	3	5	30	49	

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

*HCM 6th Ed Methodology

d) 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 Ivy Road study corridor for 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, presented in **Figure 1-17**, show the travel time along the eastbound and westbound directions on Ivy Road during both peak hours. During the AM, from 6 to 8 peak period, the travel time westbound averages 211s, and eastbound averages 218s, which is lower than the free-flow conditions. In addition, average speeds along the corridor drop below 30 MPH in both directions. During the PM peak, the average travel time is approximately 234s (eastbound) and 251s (westbound), slightly lower than the free-flow conditions. Therefore, average speeds along the corridor drop to approximately 27 MPH in both directions.

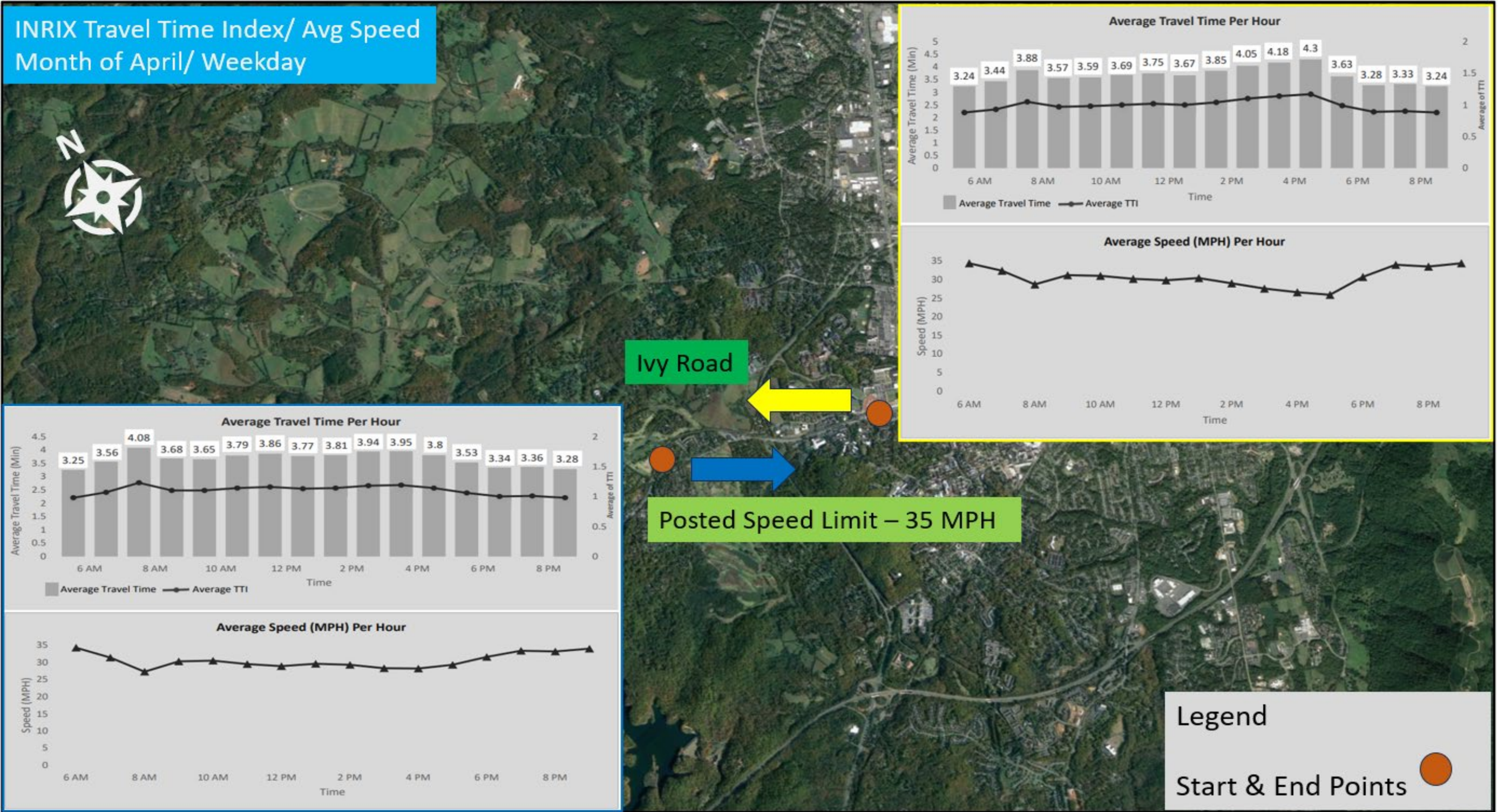


Figure 1-17. INRIX Travel Time Index and Average Speed

e) Public Involvement Survey Results – Existing Conditions

Initial public outreach was conducted to inform the public of the study efforts and goals and to solicit feedback on the public's priorities and perceptions of the corridor in evaluating potential alternatives. The survey was conducted through Publicinput.com, and there were 1,440 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, congestion mitigation, bicycle and pedestrian accessibility/connectivity, access, and transit accessibility/connectivity, as shown in **Figure 1-18**, which presents a chart summarizing the survey responses.

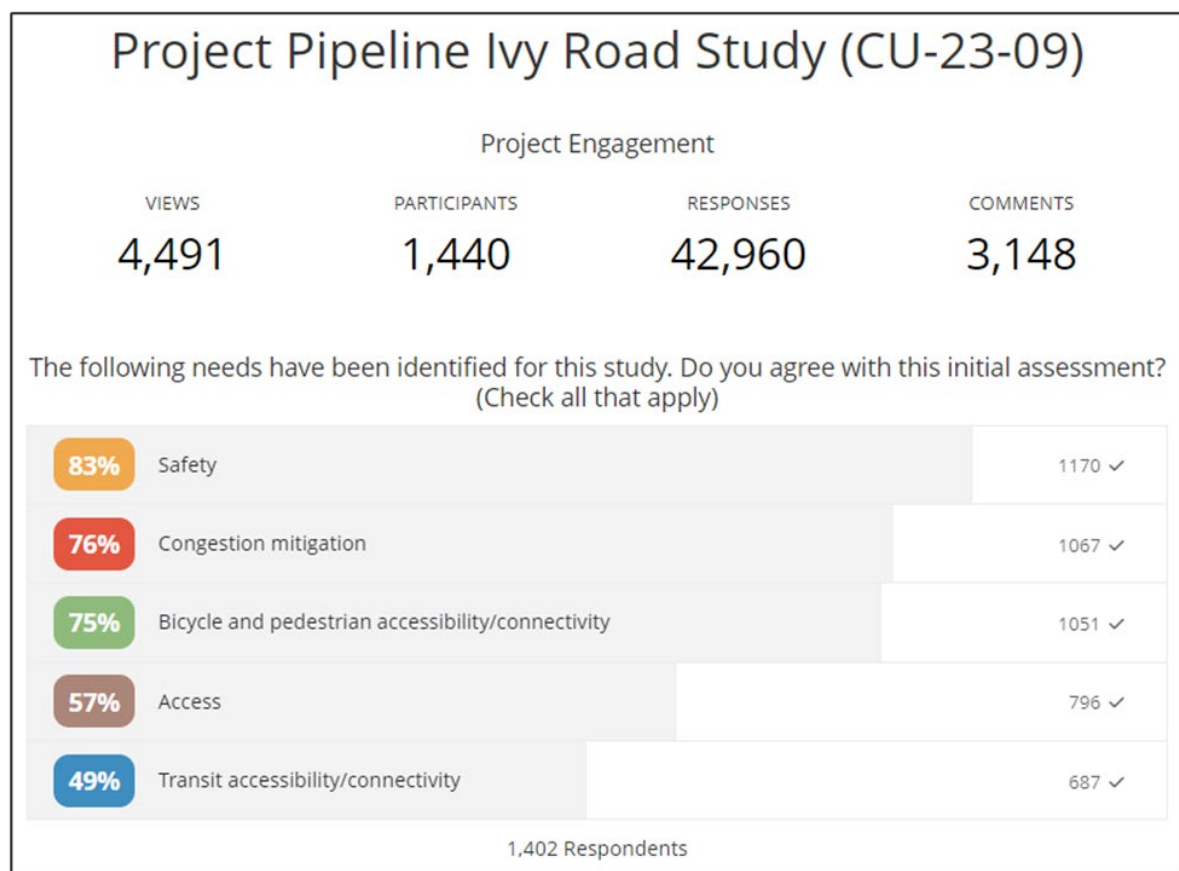


Figure 1-18. Ivy Road – Public Input Survey Results

Figure 1-19 shows a summary of the written comments along the corridor that needed to be addressed based on the keywords mentioned.

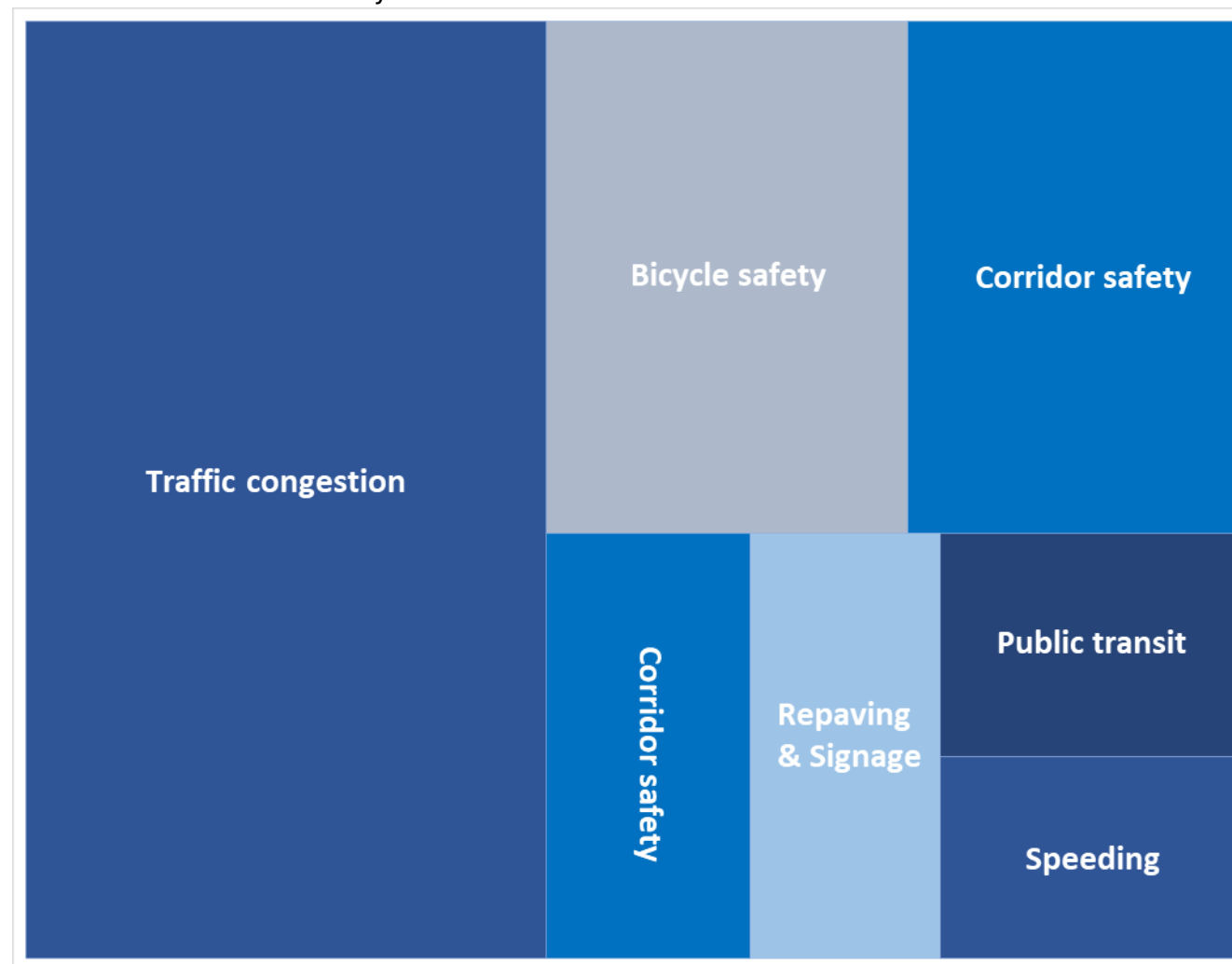


Figure 1-19. Ivy Road – Issues along the Study Corridor

Figure 1-20 summarizes the key survey responses to issues along the corridor, including pedestrian safety, traffic congestion, bicycle safety, and overall corridor safety. The majority of the respondents use the corridor for shopping/errands, passing through, or traveling to work. Additionally, 94% of the respondents travel using personal vehicles. Regarding multimodal facility needs along the corridor, 67% noted bicycle lanes are needed, 66% of respondents agree that sidewalks are needed, and 65% agree that crosswalks/pedestrian signals are needed along this corridor.

The notable written comments from the survey responses are summarized below:

- Difficult making left turns at unsignalized intersections.
- Due to high volume, there is moderate traffic congestion at US 29/250 Bypass Ramps, particularly to and from Old Ivy Road.
- There is a lack of crosswalks/ pedestrian signals along the corridor, especially at the US 29 SB off-ramp and US 29 NB off-ramp.
- Improve corridor safety and bicycle safety along the corridor.

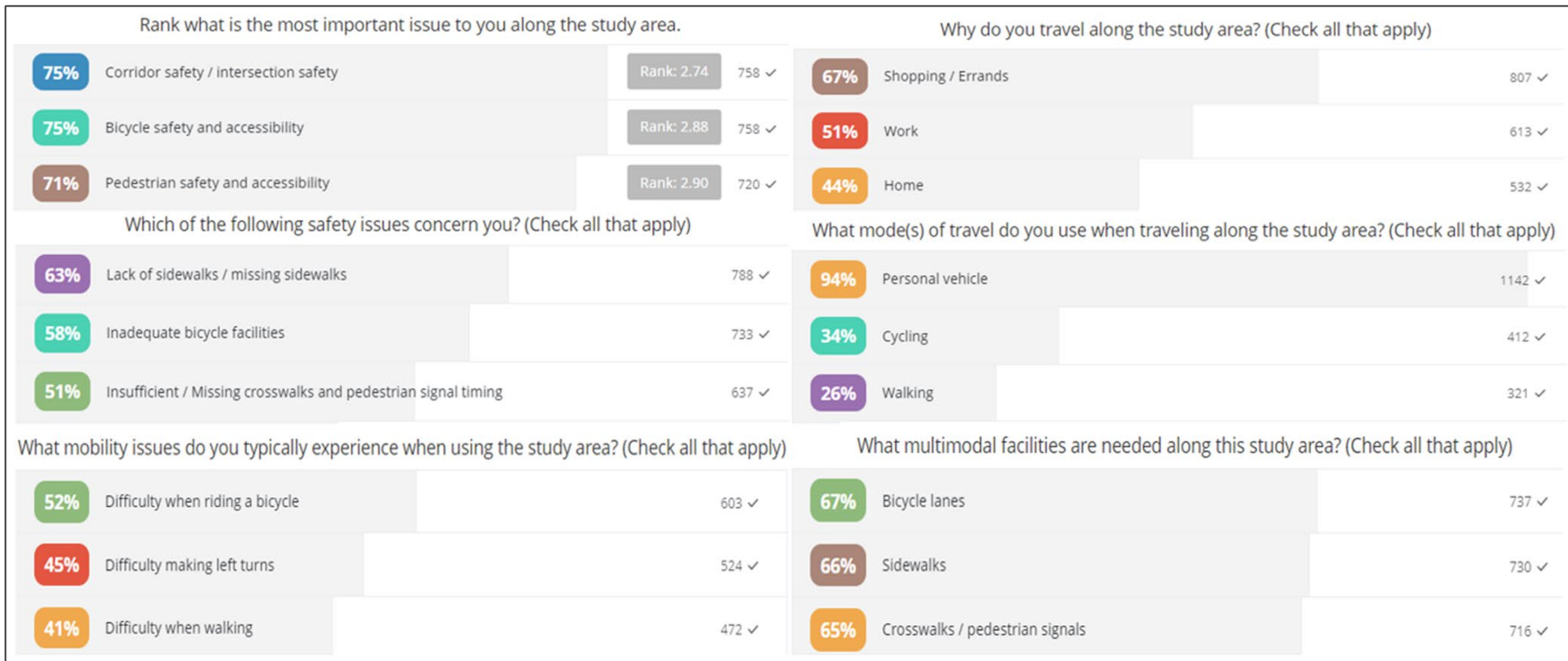


Figure 1-20. Ivy Road – Public Input Survey Responses

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
- 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 future year volumes 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 -0.02% to 2.06% on the study area roads. Ivy Road growth rates ranged from 0.30% to 0.78% annually. Old Ivy Road was only forecast to grow at 0.06% 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 1-9**.

c) Future Years 2035 & 2045 Forecast

The recommendation is for modest annual growth rates on Ivy Road and the intersecting roads in line with all three forecasting methods. Ivy Road's final recommended annual growth rate is 0.5% throughout the study area. 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.

Traffic from the approved Old Ivy Residences was added to the background growth, substantially increasing traffic volumes on Old Ivy Road. To a lesser degree, Old Ivy Residences adds traffic to other roads in the study area. The Old Ivy Residences will add a mix of 525 housing units. The forecast adds trips from Old Ivy Residences using the information submitted in their TIA (July 19th, 2021).

The recommended growth rates and Old Ivy Residences traffic were applied to the existing peak hour volumes to estimate future year 2035 and 2045 peak hour volumes. The balanced peak hour volumes for No Build 2035 are shown in **Figure 1-21** through **Figure 1-24**, and No Build 2045 are shown in **Figure 1-25** through

Figure 1-28.

Table 1-9. Ivy Road – Growth Rate Comparison & Recommended Growth Rate

Road (segments)	Road (segments)	VDOT Historical (AADT)	VDOT SPS Annual Rates	Charlottesville-Albemarle TDM Data (AAWDT)	Final Recommended Annual Growth Rates
Road	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)	
Ivy Rd	East of Alderman Rd	-1.02%	0.50%	0.30%	0.50%
Ivy Rd	Alderman Rd to Old Ivy Rd	-1.02%	0.50%	0.63%	0.50%
Ivy Rd	Old Ivy Rd to Canterbury Rd	-0.53%	0.50%	0.66%	0.50%
Ivy Rd	West of Canterbury Rd	-0.81%	0.50%	0.78%	0.50%
Alderman Rd	South of Ivy Rd	-1.16%	0.50%	1.15%	0.50%
Copeley	North of Ivy Rd	-	-	1.53%	0.50%
Old Ivy Rd	North of Ivy Rd	2.96%	2.14%	0.06%	0.50%
NB/EB Off-ramp to Ivy	-	-	0.50%	0.86%	0.50%
NB/EB On-ramp from Ivy	-	-	0.50%	0.22%	0.50%
SB/WB Off-ramp to Ivy	-	-	0.50%	2.06%	0.50%
SB/EB On-ramp from EB Ivy	-	-	0.50%	0.23%	0.50%
NB/EB On-ramp from Old Ivy	-	0%	0.50%	0.21%	0.50%
SB/WB Off-Ramp to Old Ivy	-	-	0.50%	-0.02%	0.50%
Canterbury Rd	South of Ivy Rd	0.78%	0.75%	0.97%	0.50%
Old Garth Rd	North of Ivy Rd	-	0.50%	0.60%	0.50%

Figure 1-21. Ivy Road – 2035 Balanced Peak Hour Volumes (1 of 4)



Figure 1-22. Ivy Road – 2035 Balanced Peak Hour Volumes (2 of 4)



Figure 1-23. Ivy Road – 2035 Balanced Peak Hour Volumes (3 of 4)

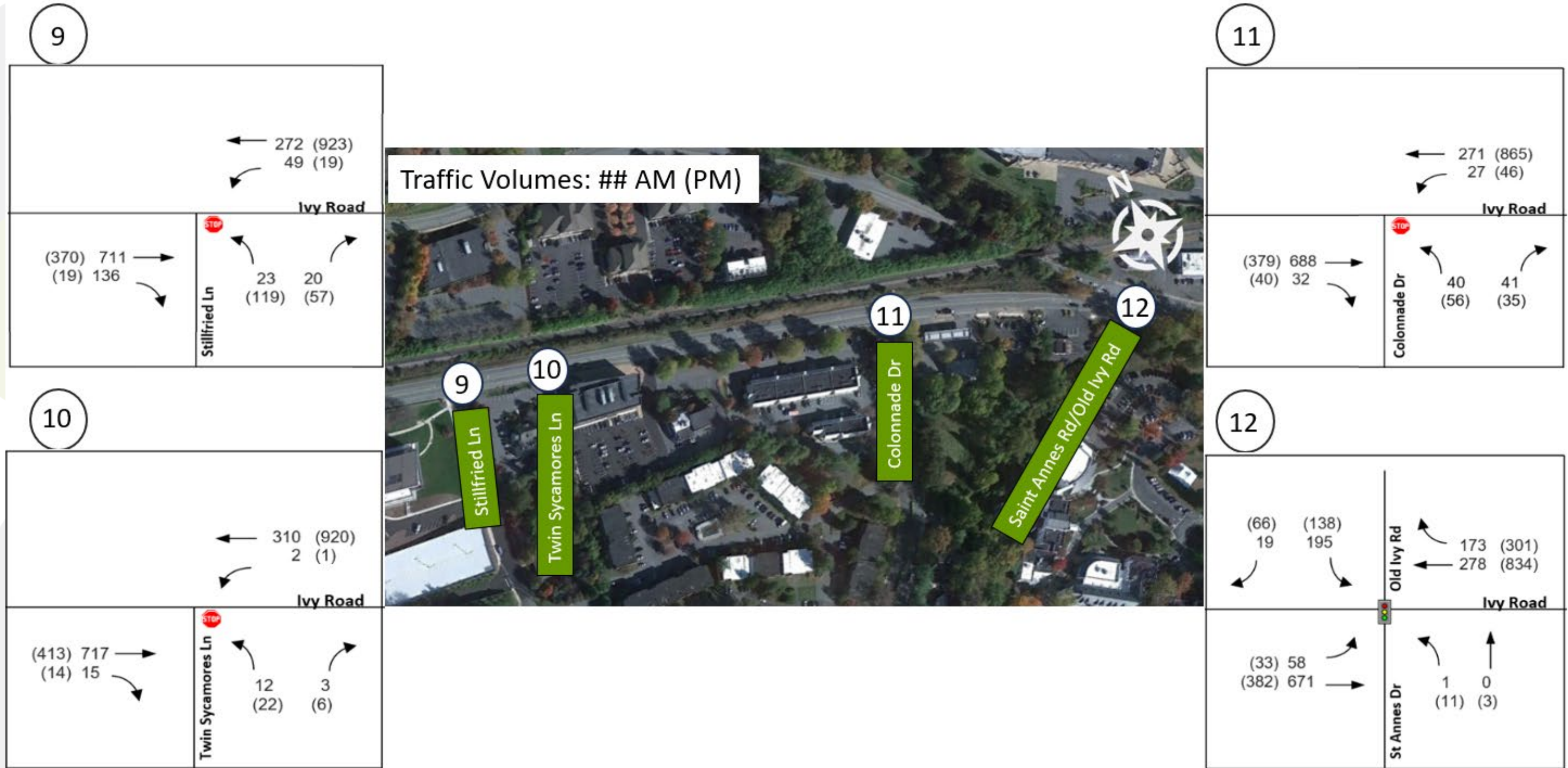


Figure 1-24. Ivy Road – 2035 Balanced Peak Hour Volumes (4 of 4)



Figure 1-25. Ivy Road – 2045 Balanced Peak Hour Volumes (1 of 4)



Figure 1-26. Ivy Road – 2045 Balanced Peak Hour Volumes (2 of 4)

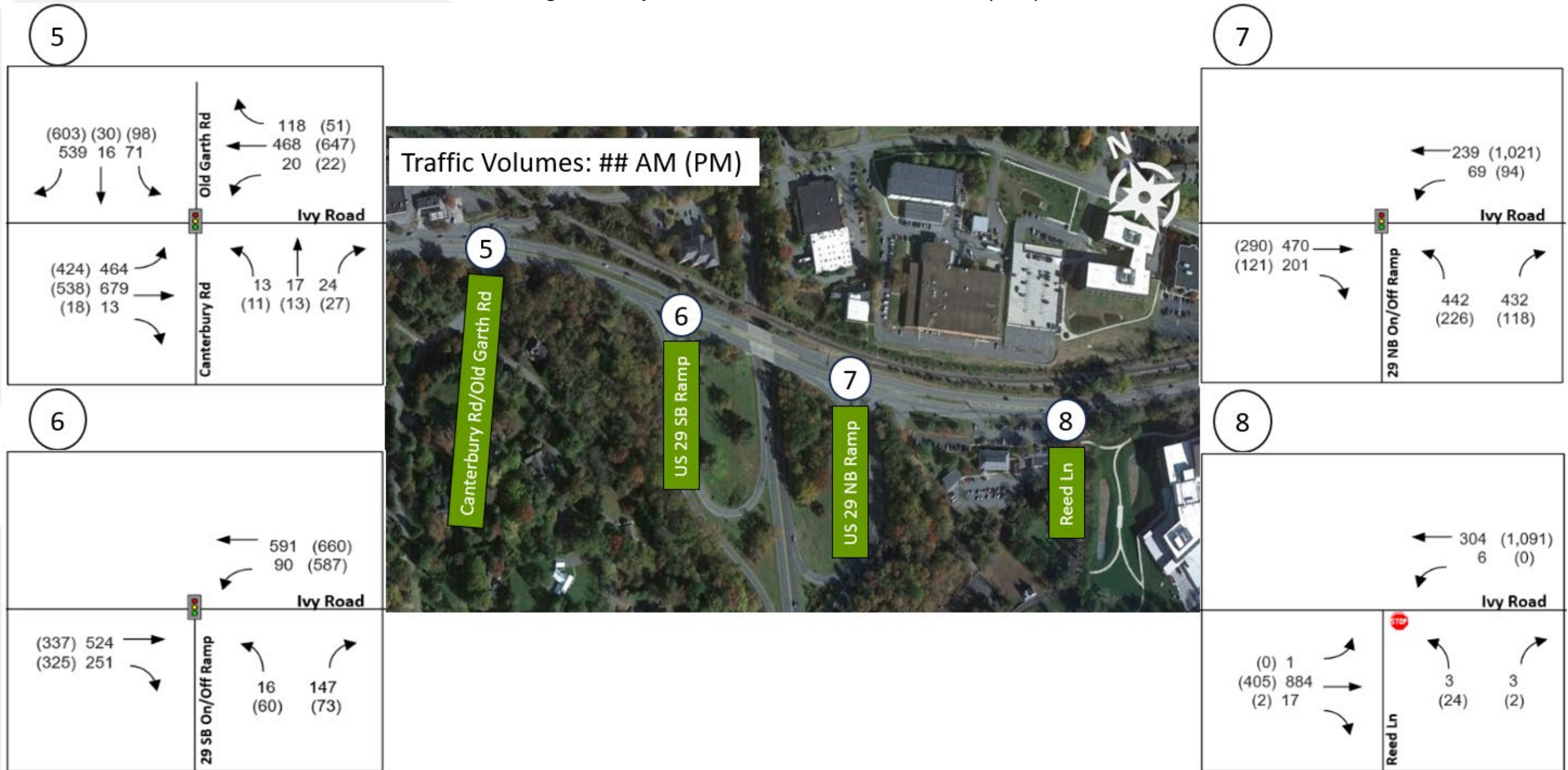


Figure 1-27. Ivy Road – 2045 Balanced Peak Hour Volumes (3 of 4)

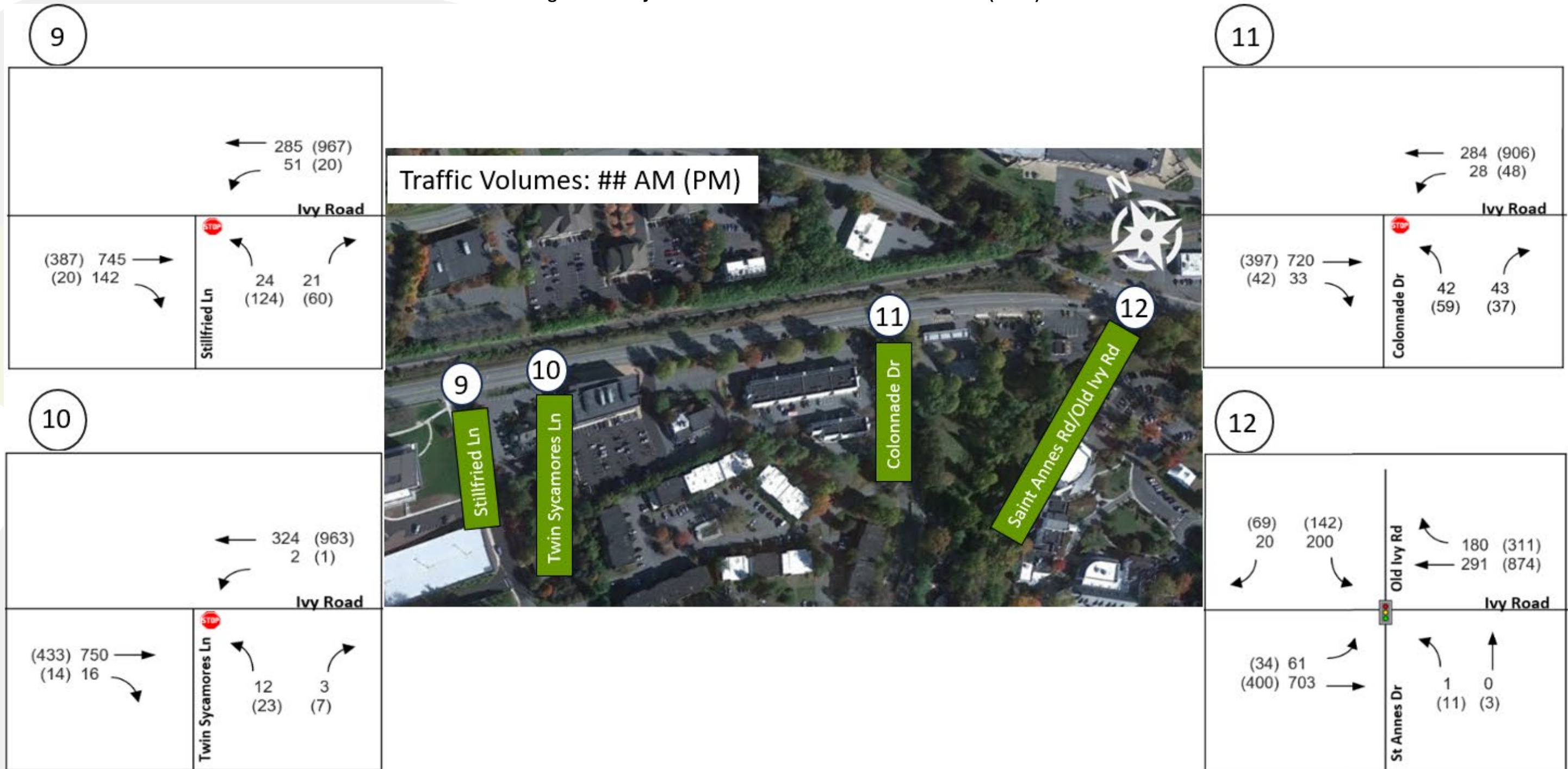


Figure 1-28. Ivy Road – 2045 Balanced Peak Hour Volumes (4 of 4)



Chapter 2 – Alternative Development and Refinement

A future year 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 to 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 addresses 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.

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**, indicate that:

- The Ivy Road intersection at Ednam Drive is forecast to operate at an overall intersection LOS B / A during the AM / PM peak hours, respectively. However, the northbound left-turn movement is predicted to experience a poor level of service, specifically LOS E during the AM peak hour and LOS D during the PM peak hour. Northbound left-turn 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 Ivy Road intersection at Farmington Drive is expected to operate at an overall LOS B / C during the AM / PM peak hours, respectively. However, there are exceptions: The northbound and southbound approaches are forecast to experience a lower level of service, specifically LOS E during the AM and PM peak hours. The westbound through movement is forecast to operate at LOS D during the PM peak hour.

- The Ivy Road intersection at Boxwood Estate Road is expected to maintain a LOS of A for all movements during the AM and PM peak hours.
- The Ivy Road intersection at Boars Head Drive/Colridge Drive is forecasted to maintain a LOS of A for all movements during the AM and PM peak hours. However, there's an exception: the northbound approach is projected to experience a lower level of service, specifically LOS D during the AM peak hour and LOS E during the PM peak hour. Moreover, the southbound approach is expected to experience a lower level of service, specifically LOS C during the AM peak hour and LOS F during the PM peak hour.
- The Ivy Road intersection at Canterbury Road/Old Garth Road is expected to operate at an overall LOS C / D during the AM / PM peak hours. However, there are specific individual movement exceptions: the northbound and southbound approaches are forecast to experience a lower level of service, specifically LOS E, during the AM and PM peak hours. The eastbound left-turn movement is projected to operate at LOS D during the AM and PM peak hours. The southbound approach queue spillback is approximately 1,400 feet (impacting southbound Bypass operations). Due to a very short southbound right turn lane, southbound through and left-turn vehicles block right turns, causing lengthy southbound queues. The eastbound left turn is forecast to develop a moderate queue length of approximately 490 feet in the PM peak hour.
- The Ivy Road intersection at the US 29 SB Off-Ramp is forecasted to operate at an overall LOS B / C during the AM and PM peak hours, respectively. However, there are specific individual movement exceptions: the northbound approach is anticipated to experience a lower level of service, specifically LOS D during the AM peak hour and LOS E during the PM peak hour. The westbound left-turn movement is forecast to operate at LOS D during the AM peak hour.
- The Ivy Road intersection at the US 29 NB Off-Ramp is expected to operate at an overall LOS C / B during the AM and PM peak hours, respectively. The northbound left-turn movement is forecast to experience a lower level of service, specifically LOS D during the AM peak hour and LOS E during the PM peak hour. The northbound right-turn movement is projected to operate at LOS D during the PM peak hour.
- The Ivy Road intersection at Reed Road is anticipated to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, there's an exception: the northbound approach is forecast to experience a lower level of service, specifically LOS E, during the PM peak hour.
- The Ivy Road intersection at Stillfried Lane is expected to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, there's an exception: the northbound left-turn movement is predicted to experience a lower level of service, specifically LOS F, during the PM peak hour.
- The Ivy Road intersection at Twin Sycamores Lane is forecasted to maintain a LOS of A for all movements during the AM and PM peak hours. However, the northbound approach is forecast to experience a lower level of service, specifically LOS C, during the AM peak hour and LOS D during the PM peak hour.

- The Ivy Road intersection at Colonnade Drive is expected to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, the northbound approach is forecast to experience a lower level of service, specifically LOS E, during the PM peak hour.
- The Ivy Road intersection at Old Ivy Road is forecasted to operate at an overall LOS B during the AM and PM peak hours. However, there are exceptions: the northbound approach is anticipated to experience a lower level of service, specifically LOS C during the AM peak hour and LOS D during the PM peak hour. The southbound approach is predicted to operate at LOS C during the AM and PM peak hours.
- The Ivy Road intersection at Saint Annes Road is expected to maintain a LOS of C or better for all movements during the AM and PM peak hours.
- The Ivy Road intersection at the Alderman Road/ Copeley Road is forecasted to operate at an overall LOS B / C during the AM and PM peak hours, respectively. All individual movements are projected to operate at LOS C or better.

Table 2-1. Ivy Road - 2035 No-Build Intersection Analysis Results

No.	Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		Sim Traffic NB 2035 Delay (sec/veh)		NB 2035 SIM Traffic LOS		NB 2035 % (f)
				AM	PM	AM	PM	AM	PM	AM	PM	
1	Ivy Rd at Ednam Dr -Signalized-	EB	EBL/T	18.9	10.4	B	B	5.4	8.0	A	A	820
			EBR	5.5	5.8	A	A	2.8	5.2	A	A	13
		WB	WBL	26.9	0.8	C	A	24.6	13.1	C	B	30
			WBT	2.0	3.3	A	A	3.5	7.9	A	A	1
		NB	NBL	55.5	53.6	E	D	105.3	44.1	F	D	48
			NBR	54.2	52.0	D	D	126.0	47.0	F	D	37
OVERALL				14.0	9.9	B	A	9.3	11.6	A	B	
2	Ivy Rd at Farmington Dr -Signalized-	EB	EBL	1.5	25.1	A	C	11.5	25.6	B	C	m2
			EBR	5.4	7.7	A	A	1.5	3.6	A	A	m0
			EBT	7.0	9.3	A	A	6.0	8.2	A	A	#1078
		WB	WBL	15.3	21.9	B	C	20.9	20.0	C	B	m6
			WBR	5.3	9.8	A	A	4.0	9.7	A	A	m45
			WBT	13.5	37.4	B	D	5.3	12.3	A	B	585
		NB	NBL/T	57.5	58.3	E	E	52.8	61.0	D	E	23
			NBR	56.3	56.0	E	E	57.5	64.2	E	E	0
		SB	SBL/T	59.5	56.6	E	E	61.9	53.2	E	D	57
			SBR	59.5	56.6	E	E	22.4	33.1	C	C	57
OVERALL				11.0	27.2	B	C	7.4	13.5	A	B	
3	Ivy Rd at Canterbury Rd -Signalized-	EB	EBL	39.2	42.5	D	D	56.1	132.5	E	F	#539
			EBR	8.3	9.4	A	A	9.7	35.2	A	D	m0
			EBT	9.1	14.4	A	B	17.0	44.3	B	D	443
		WB	WBL	10.3	18.5	B	B	112.1	67.3	F	E	m13
			WBR/T	32.9	42.7	C	D	113.0	68.3	F	E	#541
		NB	NBL/T	57.0	62.0	E	E	59.4	63.5	E	E	56
			NBR	54.9	60.1	D	E	51.0	59.0	D	E	0
		SB	SBL/T	58.0	63.3	E	E	293.3	354.8	F	F	119
			SBR	33.0	42.1	C	D	257.9	338.7	F	F	223
		OVERALL				28.6	37.3	C	D	109.7	143.6	F
4	Ivy Rd at US 29 SB Ramp -Signalized-	EB	EBR	11.1	20.8	B	C	6.1	10.6	A	B	41
			EBT	6.1	20.4	A	C	6.5	21.9	A	C	119
			WBL	53.1	33.2	D	C	62.8	48.4	E	D	108
		WB	WBT	5.3	2.9	A	A	61.4	13.5	E	B	365
			NBL	53.9	60.5	D	E	283.0	70.6	F	E	34
			NBR	53.2	55.9	D	E	6.7	2.9	A	A	63
OVERALL				13.9	21.0	B	C	31.9	26.2	C	C	

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

*HCM 2000 Methodology

Table 2-2. Ivy Road - 2035 No-Build Intersection Analysis Results (Continued)

No.	Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		Sim Traffic NB 2035 Delay (sec/veh)		NB 2035 SIM Traffic LOS		NB 95th
				AM	PM	AM	PM	AM	PM	AM	PM	
5	Ivy Rd at US 29 NB Ramp -Signalized-	EB	EBR	1.3	1.1	A	A	6.6	6.4	A	A	2
			EBT	7.5	4.2	A	A	26.7	7.0	C	A	53
		WB	WBL	15.8	5.9	B	A	42.2	11.1	D	B	61
			WBT	13.4	8.0	B	A	33.6	8.4	C	A	85
		NB	NBL	42.3	60.9	D	E	93.9	50.1	F	D	382
			NBR	32.7	45.3	C	D	74.0	11.9	E	B	183
		OVERALL	22.1	15.6	C	B	52.7	13.5	D	B		
6	Ivy Rd at Old Ivy Rd/St Annes Dr -Signalized-	EB	EBL	8.3	8.4	A	A	14.0	38.1	B	D	40
			EBT	13.6	8.6	B	A	8.4	6.4	A	A	425
		WB	WBR	9.0	8.8	A	A	5.1	6.4	A	A	98
			WBT	9.5	17.4	A	B	5.6	10.0	A	A	152
		NB	NBL/R/T	31.6	41.5	C	D	29.1	37.4	C	D	6
		SB	SBL/R/T	23.9	32.8	C	C	24.6	43.2	C	D	157
		OVERALL	13.6	15.8	B	B	10.1	13.0	B	B		
7	Ivy Rd at Alderman Rd/Copeley Rd -Signalized-	EB	EBL	8.1	10.5	A	B	11.7	16.2	B	B	53
			EBR	11.6	11.8	B	B	11.0	8.7	B	A	32
			EBT	23.6	15.0	C	B	15.2	12.3	B	B	467
		WB	WBL	13.4	13.7	B	B	15.9	13.3	B	B	30
			WBR/T	15.1	22.7	B	C	4.9	9.2	A	A	94
			WBT	15.1	22.7	B	C	11.4	18.7	B	B	94
		NB	NBL	18.2	17.7	B	B	20.1	22.2	C	C	83
			NBR/T	18.0	16.4	B	B	23.0	12.7	C	B	87
		SB	SBL	25.9	26.8	C	C	24.8	26.9	C	C	48
			SBR/T	27.4	26.9	C	C	10.5	14.2	B	B	135
OVERALL	19.4	20.1	B	C	14.5	16.8	B	B				

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

*HCM 2000 Methodology

Table 2-3. Ivy Road - 2035 No-Build Intersection Analysis Results (Continued)

No.	Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		Sim Traffic NB 2035 Delay (sec/veh)		NB 2035 SIM Traffic LOS		NB 2035 95th % (Veh)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
8	Ivy Rd at Boxwood Estate Rd -Unsignalized-	EB	EBL	0.0	0.0	A	A	6.6	0.0	A	A	0	0
			EBT	0.0	0.0	A	A	2.0	1.8	A	A	0	0
		WB	WBR/T	0.0	0.0	A	A	1.9	2.0	A	A	0	0
			SB	SBL/R	0.0	0.0	A	A	30.3	28.3	D	D	0
9	Ivy Rd at Boars Head Dr/Colridge Dr -Unsignalized-	EB	EBL	12.2	18.9	B	C	7.3	6.6	A	A	0	0
			EBR	0.0	0.2	A	A	1.8	1.8	A	A	0	0
			EBT	0.0	0.2	A	A	3.0	2.9	A	A	0	0
		WB	WBL	0.0	0.0	A	A	16.7	15.7	C	C	0	0
			WBR	0.0	0.0	A	A	3.0	4.6	A	A	0	0
			WBT	0.0	0.0	A	A	5.1	7.1	A	A	0	0
NB	NBL/R/T	29.8	38.5	D	E	43.5	61.9	E	F	30	7		
SB	SBL/R/T	16.1	263.2	C	F	45.0	105.8	E	F	3	3		
10	Ivy Rd at Reed Ln -Unsignalized-	EB	EBL/T	0.0	0.0	A	A	0.7	0.3	A	A	0	0
			EBR	0.0	0.0	A	A	0.5	0.4	A	A	0	0
		WB	WBL	9.9	0.0	A	A	10.1	1.4	B	A	0	0
			WBT	0.2	0.0	A	A	0.6	1.4	A	A	0	0
NB	NBL/R	19.9	37.3	C	E	32.4	4.4	D	A	3	1		
11	Ivy Rd at Stillfried Ln -Unsignalized-	EB	EBL/T	0.0	0.0	A	A	1.4	0.8	A	A	0	0
			EBR	0.0	0.0	A	A	1.1	0.4	A	A	0	0
		WB	WBL	0.0	0.0	A	A	7.2	3.3	A	A	0	0
			WBT	0.0	0.0	A	A	0.2	0.6	A	A	0	0
NB	NBL	23.7	97.5	C	F	18.9	50.7	C	F	10	1		
	NBR	14.4	11.1	B	B	7.8	19.5	A	C	5	0		
12	Ivy Rd at Twin Sycamores Ln -Unsignalized-	EB	EBL/R/T	0.0	0.0	A	A	0.5	0.5	A	A	0	0
			WBL	9.3	8.2	A	A	7.8	0.0	A	A	0	0
		WB	WBT	0.1	0.0	A	A	0.5	1.0	A	A	0	0
			NB	NBL/R	20.6	30.8	C	D	11.8	28.6	B	D	5

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. Ivy Road - 2035 No-Build Intersection Analysis Results

No.	Intersection	Approach	Lane Group	HCM NB 2035 Delay (sec/veh)		NB 2035 HCM LOS		Sim Traffic NB 2035 Delay (sec/veh)		NB 2035 SIM Traffic LOS		NB 2035 95th % (Veh)		N
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
13	Ivy Rd at Colonnade Dr -Unsignalized-	EB	EBL/T	0	0	A	A	0.7	0.5	A	A	0	0	C
			EBR	0	0	A	A	0.2	0.2	A	A	0	0	2
		WB	WBL	9.4	8.4	A	A	6.1	5.2	A	A	3	3	4
			WBT	0.8	0.4	A	A	1.5	2.6	A	A	0	0	C
NB	NBL/R	22.5	40.4	C	E	14.5	30.3	B	D	30	63	9		
14	Ivy Rd at Saint Annes Rd -Unsignalized-	EB	EBL/R/T	0	0	A	A	3	2	A	A	0	0	3
			WBL	10	9	A	A	10	9	A	A	3	0	3
		WB	WBT	0	0	A	A	2	3	A	A	0	0	4
			NB	NBL/R	16	14	C	B	23	31	C	D	3	5

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

*HCM 6th Ed Methodology

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**, indicate that:

- The overall Ivy Road intersection at Ednam Drive is forecast to operate at LOS B during the AM and PM peak hours. However, the northbound approach is projected to experience a poor level of service, specifically LOS E during the AM peak hour and LOS D 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 Ivy Road intersection at Farmington Drive is expected to operate at an overall LOS B / C during the AM and PM peak hours, respectively. However, the northbound and southbound approaches are anticipated to experience a lower level of service, specifically LOS E, during the AM and PM peak hours. The westbound through movement is expected to operate at LOS D during the PM peak hour.
- The Ivy Road intersection at Boxwood Estate Road is predicted to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, there's an exception: the southbound approach is predicted to experience a lower level of service, specifically LOS D during the AM peak hour and LOS E during the PM peak hour.
- The Ivy Road intersection at Boars Head Drive/Colridge Drive is expected to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, there's an exception: The northbound approach is forecast to experience a lower level of service, specifically LOS E during the AM peak hour and LOS F during the PM peak hour. The southbound approach is forecast to operate at an even lower level of service, specifically LOS F, during both peak hours.
- The Ivy Road intersection at the Canterbury Road/Old Garth Road is forecast to operate at an overall LOS C / D during the AM and PM peak hours, respectively. However, there are specific exceptions: the northbound left-turn movement is projected to experience a lower level of service, specifically LOS E, during both peak hours. The southbound left-turn movement is estimated to experience a lower level of service, specifically LOS E during the AM peak hour and LOS F during the PM peak hour. In addition, the eastbound left-turn movement is forecast to operate at LOS D during the AM peak and LOS E during the PM peak hour. The southbound approach queue spillback is anticipated to reach approximately 1,470 feet. The heavy southbound through and left-turn volumes during both peaks cause lengthy queueing, blocking the southbound right-turn movement. The

eastbound left turn is projected to develop moderate queue lengths of approximately 500 feet.

- The Ivy Road intersection at the US 29 SB Off-Ramp is expected to operate at an overall LOS B / C during the AM and PM peak hours, respectively. However, there are exceptions: the northbound approach is forecast to experience a lower level of service, specifically LOS D during the AM peak hour and LOS E during the PM peak hour. The westbound left-turn movement is projected to operate at LOS D during both peak hours.
- The Ivy Road intersection at the US 29 NB Off-Ramp is predicted to operate at an overall LOS C / B during the AM and PM peak hours, respectively. However, there are exceptions: the northbound left-turn approach is forecast to experience a lower level of service, specifically LOS D during the AM peak hour and LOS E during the PM peak hour. The northbound right-turn movement is expected to operate at LOS E during the PM peak hour.
- The Ivy Road intersection at Reed Road is expected to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, there's an exception: the northbound approach is forecast to experience LOS E during the PM peak hour.
- The Ivy Road intersection at Stillfried Lane is projected to maintain a LOS of C or better for all movements during both peak hours. However, there's an exception: the northbound left-turn movement is predicted to experience a lower level of service, specifically LOS D during the AM peak and LOS F during the PM peak hour.
- The Ivy Road intersection at Twin Sycamores Lane is forecast to maintain a LOS of C or better for all movements during both peak hours. However, there's an exception: the northbound approach is anticipated to experience a lower level of service, specifically LOS D, during the PM peak hour.
- The Ivy Road intersection at Colonnade Drive is expected to maintain a LOS of C or better for all movements during the AM and PM peak hours. However, there's an exception: the northbound approach is forecast to experience a lower level of service, specifically LOS E, during the PM peak hour.
- The Ivy Road intersection at the Old Ivy Road is predicted to operate at an overall LOS B during both peak hours. However, there are exceptions: the northbound and southbound approaches are forecast to experience a lower level of service, specifically LOS C, during the AM peak hour and LOS D during the PM peak hour.
- The Ivy Road intersection at Saint Annes Road is expected to maintain a LOS of C or better for all movements during both peak hours.
- The Ivy Road intersection at the Alderman Road/ Copeley Road is forecast to operate at an overall LOS C during the AM and PM peak hours. All individual movements are projected to operate at LOS C or better.

Table 2-5. Ivy Road - 2045 No-Build Intersection Analysis Results

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		Sim Traffic NB 2045 Delay (sec/veh)		NB 2045 SIM Traffic LOS		NB
				AM	PM	AM	PM	AM	PM	AM	PM	
1	Ivy Rd at Ednam Dr -Signalized-	EB	EBL/T	19.6	10.9	B	B	9.5	7.8	A	A	94
			EBR	5.2	5.8	A	A	5.1	5.3	A	A	13
		WB	WBL	26.1	1.1	C	A	32.5	12.5	C	B	m4
			WBT	1.0	4.0	A	A	4.1	7.5	A	A	1
		NB	NBL	60.3	53.6	E	D	80.5	45.1	F	D	52
			NBR	58.8	52.0	E	D	86.6	47.9	F	D	38
OVERALL				14.1	10.4	B	B	11.5	11.5	B	B	
2	Ivy Rd at Farmington Dr -Signalized-	EB	EBL	1.1	32.5	A	C	12.9	22.3	B	C	m:
			EBR	5.5	7.9	A	A	2.8	3.0	A	A	m(
			EBT	7.8	10.9	A	B	7.0	9.5	A	A	#12
		WB	WBL	18.8	15.4	B	B	24.1	16.5	C	B	9
			WBR	6.5	10.0	A	A	5.1	6.5	A	A	62
			WBT	14.3	45.3	B	D	7.4	10.6	A	B	68
		NB	NBL/T	62.9	58.3	E	E	62.4	58.3	E	E	27
			NBR	61.2	56.0	E	E	63.6	56.2	E	E	0
		SB	SBL/T	61.9	57.3	E	E	64.8	53.3	E	D	62
			SBR	61.9	57.3	E	E	24.3	31.1	C	C	62
OVERALL				11.9	31.8	B	C	9.1	13.2	A	B	
3	Ivy Rd at Canterbury Rd -Signalized-	EB	EBL	37.2	57.2	D	E	135.8	40.7	F	D	#45
			EBR	8.8	8.1	A	A	51.8	7.4	D	A	0.(
			EBT	16.8	12.7	B	B	58.9	9.8	E	A	56
		WB	WBL	12.9	16.2	B	B	91.4	58.0	F	E	m1
			WBR/T	31.3	43.3	C	D	112.3	54.9	F	D	#34
		NB	NBL/T	56.9	62.0	E	E	67.3	66.6	E	E	57
			NBR	54.8	60.1	D	E	53.5	58.6	D	E	0
		SB	SBL/T	58.8	111.0	E	F	352.3	558.2	F	F	12
			SBR	36.3	49.8	D	D	322.8	496.6	F	F	21
		OVERALL				30.7	43.9	C	D	150.2	127.3	F
4	Ivy Rd at US 29 SB Ramp -Signalized-	EB	EBR	1.9	14.0	A	B	7.3	10.1	A	B	4
			EBT	2.1	22.6	A	C	7.7	26.2	A	C	33
			WBL	45.2	41.3	D	D	59.7	35.9	E	D	11
		WB	WBT	8.7	2.9	A	A	43.6	12.1	D	B	39
			NBL	53.9	60.0	D	E	469.5	97.7	F	F	36
			NBR	53.2	55.5	D	E	14.8	4.5	B	A	65
OVERALL				12.0	22.6	B	C	28.7	23.8	C	C	

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

Table 2-6. Ivy Road - 2045 No-Build Intersection Analysis Results (Continued)

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		Sim Traffic NB 2045 Delay (sec/veh)		NB 2045 SIM Traffic LOS		NB 2045 95th %	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
5	Ivy Rd at US 29 NB Ramp -Signalized-	EB	EBR	9.0	5.6	A	A	7.0	7.3	A	A	45	m
			EBT	8.8	1.0	A	A	32.7	10.6	C	B	188	m
		WB	WBL	14.5	6.1	B	A	30.1	16.0	C	B	65	5
			WBT	14.2	8.5	B	A	27.4	9.5	C	A	92	2
		NB	NBL	41.6	60.8	D	E	109.3	47.7	F	D	391	2
			NBR	32.2	60.8	C	E	82.8	12.1	F	B	197	
OVERALL				24.9	16.1	C	B	58.8	14.9	E	B		
6	Ivy Rd at Old Ivy Rd/St Annes Dr -Signalized-	EB	EBL	8.4	8.6	A	A	14.9	46.7	B	D	42	
			EBT	14.3	8.4	B	A	8.5	6.6	A	A	467	2
		WB	WBR	9.1	8.6	A	A	5.8	7.0	A	A	103	2
			WBT	9.6	18.0	A	B	6.0	10.2	A	B	164	6
		NB	NBL/R/T	32.8	44.0	C	D	36.5	41.4	D	D	6	
		SB	SBL/R/T	24.8	36.1	C	D	26.8	50.2	C	D	169	#
OVERALL				14.1	16.4	B	B	10.6	14.3	B	B		
7	Ivy Rd at Alderman Rd/Copeley Rd -Signalized-	EB	EBL	8.7	11.2	A	B	12.8	17.2	B	B	57	
			EBR	12.3	12.0	B	B	11.0	8.8	B	A	35	
			EBT	27.3	15.5	C	B	16.4	12.3	B	B	505	2
		WB	WBL	13.0	13.9	B	B	15.5	13.3	B	B	33	
			WBR/T	14.7	23.3	B	C	5.4	10.1	A	B	100	3
			WBT	14.7	23.3	B	C	12.0	19.3	B	B	100	3
		NB	NBL	19.8	18.6	B	B	20.6	24.7	C	C	90	2
			NBR/T	19.5	17.1	B	B	12.7	12.3	B	B	94	2
		SB	SBL	27.4	27.6	C	C	25.4	28.2	C	C	51	
			SBR/T	29.0	28.4	C	C	11.1	15.8	B	B	146	2
OVERALL				21.1	20.8	C	C	15.2	17.7	B	B		

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

*HCM 2000 Methodology

Table 2-7. Ivy Road - 2045 No-Build Intersection Analysis Results (Continued)

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		Sim Traffic NB 2045 Delay (sec/veh)		NB 2045 SIM Traffic LOS		NB 2045 95th % (Veh)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
8	Ivy Rd at Boxwood Estate Rd -Unsignalized-	EB	EBL	0.0	20.9	A	C	8.3	5.6	A	A	0	0
			EBT	0.0	0.1	A	A	2.4	2.1	A	A	0	0
		WB	WBR/T	0.0	0.0	A	A	2.2	1.4	A	A	0	0
			SB	SBL/R	32.0	44.3	D	E	54.2	26.1	F	D	8
9	Ivy Rd at Boars Head Dr/Colridge Dr -Unsignalized-	EB	EBL	12.8	20.9	B	C	8.2	9.2	A	A	0	0
			EBR	0.0	0.1	A	A	4.1	1.9	A	A	0	0
			EBT	0.0	0.1	A	A	7.0	2.9	A	A	0	0
		WB	WBL	0.0	0.0	A	A	60.0	14.6	F	B	0	0
			WBR	0.0	0.0	A	A	13.6	4.9	B	A	0	0
			WBT	0.0	0.0	A	A	30.8	6.8	D	A	0	0
		NB	NBL/R/T	41.0	57.0	E	F	79.5	48.1	F	E	43	10
SB	SBL/R/T	240.6	399.7	F	F	79.5	53.0	F	F	35	3		
10	Ivy Rd at Reed Ln -Unsignalized-	EB	EBL/T	0.0	0.0	A	A	3.6	0.4	A	A	0	0
			EBR	0.0	0.0	A	A	0.5	0.4	A	A	0	0
		WB	WBL	10.0	0.0	A	A	5.9	1.4	A	A	0	0
			WBT	0.2	0.0	A	A	0.6	1.4	A	A	0	0
NB	NBL/R	21.0	41.9	C	E	13.8	21.9	B	C	3	2		
11	Ivy Rd at Stillfried Ln -Unsignalized-	EB	EBL/T	0.0	0.0	A	A	1.4	1.0	A	A	0	0
			EBR	0.0	0.0	A	A	1.1	0.5	A	A	0	0
		WB	WBL	0.0	0.0	A	A	7.1	4.0	A	A	0	0
			WBT	0.0	0.0	A	A	0.2	0.6	A	A	0	0
		NB	NBL	25.4	135.2	D	F	19.4	58.2	C	F	10	1
NBR	20.5	11.3	C	B	8.4	23.5	A	C	5	0			
12	Ivy Rd at Twin Sycamores Ln -Unsignalized-	EB	EBL/R/T	0.0	0.0	A	A	0.5	0.6	A	A	0	0
			WBL	9.5	8.3	A	A	3.9	1.0	A	A	0	0
		WB	WBT	0.1	0.0	A	A	0.5	1.0	A	A	0	0
			NB	NBL/R	21.8	34.0	C	D	15	29.9	B	D	18

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. Ivy Road - 2045 No-Build Intersection Analysis Results

No.	Intersection	Approach	Lane Group	HCM NB 2045 Delay (sec/veh)		NB 2045 HCM LOS		Sim Traffic NB 2045 Delay (sec/veh)		NB 2045 SIM Traffic LOS		NB 2045 95th % (Veh)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
13	Ivy Rd at Colonnade Dr -Unsignalized-	EB	EBL/T	0	0	A	A	0.7	0.5	A	A	0	0
			EBR	0	0	A	A	0.2	0.2	A	A	0	0
		WB	WBL	9.5	8.5	A	A	5.7	5.8	A	A	3	3
			WBT	0.9	0.4	A	A	1.6	2.7	A	A	0	0
NB	NBL/R	24.5	49.9	C	E	15.6	30	C	D	35	7		
14	Ivy Rd at Saint Annes Rd -Unsignalized-	EB	EBL/R/T	0	0	A	A	4	2	A	A	0	0
			WBL	10	9	A	A	12	9	B	A	3	0
		WB	WBT	0	0	A	A	2	3	A	A	0	0
			NB	NBL/R	17	15	C	B	24	32	C	D	3

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

*HCM 6th Ed Methodology

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. Analysis was conducted on the final improvement alternatives carried forward to the second public survey. The *Synchro/SimTraffic* analysis results for the year 2035 build conditions, presented in **Table 2-9** through **Table 2-22**, indicate that:

Ednam Drive Intersection: Two improvement configurations were considered in the build conditions analysis – a right-in/right-out left-in configuration and a Green-T intersection. The analysis results, presented in **Table 2-9**, can be summarized as follows:

- The Ednam Drive right-in/right-out left-in alternative at Ivy Road is expected to perform at a LOS B during the AM peak and LOS A in the PM peak hour. However, the northbound right-turn movement is forecast to operate at LOS E and LOS D during the AM and PM peak hours, respectively. The right-in/right-out performance is satisfactory, but specific movements may experience slightly higher congestion.
- The Edman Drive Green-T alternative at Ivy Road is projected to operate at an overall intersection LOS B/A during the AM and PM peak hours, respectively. The westbound left turn movement is anticipated to operate at LOS E during both peak hours. In addition, the northbound left-turn movement is forecast to operate at LOS E and LOS D during the AM and PM peak hours, respectively. The Green-T performs satisfactorily, but specific individual movements may experience moderate congestion.

Farmington Drive Intersection: Two improvement configurations were considered in the build conditions analysis – a hybrid roundabout and a right-in/right-out and left-in intersection. The analysis results, presented in **Table 2-10**, can be summarized as follows:

- The Farmington Drive at Ivy Road roundabout is forecasted to operate at LOS A during both peak hours. All individual movements are anticipated to perform at LOS B or better during peak hours. In summary, the overall performance of this roundabout is excellent, with all movements experiencing efficient traffic flow.
- The Farmington Drive at Ivy Road right-in/right-out and left-in intersection is expected to operate at LOS B/C during the AM and PM peak hours, respectively. However, the northbound approach is forecast to experience poor LOS E conditions during the AM and PM peak hours. The southbound approach is projected to experience LOS E/D during the AM and PM peak hours, respectively.

Boxwood Estate Road Intersection: One improvement configuration was considered in the build conditions analysis – an unsignalized right-in/right-out only intersection. The analysis results, presented in **Table 2-11**, can be summarized as follows:

- The Boxwood Estate Road right-in/right-out (RIRO) alternative at Ivy Road is expected to perform at LOS D or better for all the movements during both peak hours. Overall, the right-in/right-out performance is satisfactory, but the southbound movements may experience slightly higher delay.

New Interparcel connection can be summarized as follows:

- Extend Kenridge Park Road to Weedon Professional Center entrance. This extension of the frontage road has right-of-way dedicated for this purpose. This frontage road extension provides more opportunities for access management options within its vicinity. No specific traffic analysis was conducted for this alternative.

Boars Head Drive Intersection: One improvement configuration was considered in the build conditions analysis – a hybrid roundabout. The analysis results, presented in **Table 2-12**, can be summarized as follows:

- At the proposed Boars Head Drive at Ivy Road roundabout, the overall LOS during both peak hours is expected to be LOS A. Other individual movements within the roundabout are anticipated to perform at LOS C or better during both peak hours.

Boars Head Drive to Canterbury Road Access Management Improvements can be summarized as follows:

- Installation of a raised median between Boars Head Drive and Canterbury Road on Ivy Road will prevent all left turns through this segment. This improvement would necessitate U-turns, which could be accommodated at the proposed Boars Head Drive roundabout.

Canterbury Road Intersection: Two improvement alternatives were considered in the build conditions analysis – a hybrid roundabout and southbound dual right turn lanes on Old Garth Road. The analysis results, presented in **Table 2-13**, can be summarized as follows:

- At the Canterbury Road at Ivy Road roundabout, the overall LOS during the AM and PM peak hours is expected to be LOS B. All individual movements within the roundabout are anticipated to perform at LOS C or better during both peak hours. In summary, the overall performance of this roundabout is sufficient, with all movements experiencing adequate traffic flow.
- The Canterbury Road at Ivy Road overall intersection with dual SB right turn lanes alternative is expected to perform at LOS C during both peak hours. The eastbound left turn movement is anticipated to operate at LOS D during the PM peak hour. In addition, the northbound left-turn movement is projected to operate at LOS E during the AM and PM peak hours. The southbound left-turn movement is forecast to operate at LOS D and LOS F during the AM and PM peak hours, respectively. Eastbound through movement queues are forecast to reach a maximum length of 1,300 feet in the AM peak hour. The

southbound through/left movement is estimated to produce maximum queues of over 1,300 feet in both peak hours, potentially impacting operations on the Bypass.

Triangle-about at Old Garth Intersection: The analysis results, presented in **Table 2-14**, can be summarized as follows:

- A previous traffic study conducted by ATCS recommended converting the existing Old Garth Road/Old Ivy Road area from two-way streets to one-way streets within an “intersection triangle” comprised of Old Garth Road, Old Ivy Road, and Faulconer Drive. Vehicles travel in a counterclockwise direction when viewed from above. These intersections function like a large roundabout, improving the flow of vehicles between intersections and into and out of the area. Future background traffic volume was estimated in the ATCS study by growing 2019 traffic volumes to the year 2030 following VDOT traffic forecasting guidance.
- Triangle-about Intersection #1 is located at Old Garth Road, US 29 SB Off-Ramp on Old Ivy Road; the overall intersection is forecast to operate with LOS E and LOS A conditions in the AM and PM peak hours, respectively.
- Triangle-about Intersection #2 is located at Faulconer Drive on Old Ivy Road; the overall intersection is forecast to operate with LOS A conditions during the AM and PM peak hours.
- Triangle-about Intersection #3 is located at Faulconer Drive on the US 29 SB Off-Ramp segment; the overall intersection is forecast to operate with LOS B and LOS A conditions in the AM and PM peak hours, respectively.

US 29 NB on-ramp at Old Ivy Road: The analysis results, presented in **Table 2-15**, can be summarized as follows:

- Install a channelized westbound right turn lane at Old Ivy Road unsignalized intersection to improve the eastbound through traffic flow to prevent significant queuing.
- The US 29 on-ramp alternative at Old Ivy Road is expected to perform at LOS A for all the movements during both peak hours. Overall, the eastbound and westbound performance is satisfactory, but the northbound movements may experience higher delays, which is forecast at LOS F during both peak hours (this is a very low volume movement).

Extend NB and SB US 29 Acceleration/Deceleration Lanes North of Ivy Road: The analysis results, presented in **Table 2-16**, can be summarized as follows:

- These improvements on the freeway interchange ramps can reduce congestion by creating specific areas for merging or diverging traffic to speed up and slow down to a safer speed to enter or exit the main flow of traffic on the Bypass. Moreover, these ramp improvements could reduce the stop-and-go effects and collisions caused by slower traffic at interchanges.
- The Old Ivy Road at US 29 NB On-Ramp merge segment is forecast to operate with LOS B conditions in the AM and PM peak hours. In summary, the overall acceleration lane

performance is satisfactory; the build conditions improve on the No Build scenario, which has LOS C during the AM and PM peak hours.

- The Old Garth Road at US 29 SB Off-Ramp diverge segment is forecast to operate with LOS A and LOS B conditions in the AM and PM peak hours, respectively. In summary, the overall deceleration lane performance is satisfactory; the build conditions improve on the No Build scenario, which has LOS B and LOS C during the AM and PM peak hours, respectively.

Rebuild Ivy Road NB On-ramp and SB Off-ramp to Standards: The analysis results, presented in **Table 2-17**, can be summarized as follows:

- These improvements include replacing and widening the 3 bridges over US 29 to accommodate the proposed 6 lanes between Leonard Sandridge Road and Ivy Road. Bridge replacement would allow sufficient width to install standard-length acceleration and deceleration lanes beneath the bridge. Additionally, these improvements include reconstructing the railroad with two tracks to allow the replacement of overpass bridges while maintaining railroad operation.
- The Ivy Road at US 29 NB On-Ramp merge segment is forecast to operate with LOS B conditions in the AM and PM peak hours. In summary, the overall acceleration lane performance is satisfactory; the build conditions show an improvement over the No Build scenario, with small reductions in density (approximately 1-2 pc/mi/ln).
- The Ivy Road at US 29 SB Off-Ramp diverge segment is forecast to operate with LOS A and LOS B conditions in the AM and PM peak hours, respectively. In summary, the overall deceleration lane performance is satisfactory; the build conditions improve on the No Build scenario, which has LOS B and C during the AM and PM peak hours, respectively.

Extend US 29 NB Off-ramp and SB On-ramp South of Ivy Road: The analysis results, presented in **Table 2-18**, can be summarized as follows:

- These improvements on the freeway interchange directional ramps can reduce congestion by creating adequate areas for merging or diverging traffic to speed up and slow down to a safer speed to enter or exit the main flow of traffic on the Bypass. Moreover, these ramp improvements could reduce the stop-and-go effects and collisions caused by slower traffic at interchanges.
- The Ivy Road at US 29 NB Off-Ramp diverge segment is forecast to operate with LOS B conditions in the AM and PM peak hours. The overall deceleration lane performance is satisfactory; the build conditions show minor density improvement compared to the No Build scenario (approximately 3 pc/mi/ln).
- The Ivy Road at US 29 SB On-Ramp merge segment is forecast to operate with LOS A and LOS B conditions in the AM and PM peak hours, respectively. In summary, the overall acceleration lane performance is satisfactory; the build conditions show improvement over the No Build scenario in density, which has LOS B and C during the AM and PM peak hours, respectively.

US 29/US 250 Ramp Terminals: One improvement configuration was considered in the build conditions analysis for the Ivy Road ramp terminals – hybrid roundabouts. The analysis results, presented in **Table 2-19**, can be summarized as follows:

- At the US 29 SB Ramp at Ivy Road roundabout, the overall intersection is forecast to operate at LOS A and LOS B conditions in the AM and PM peak hours, respectively. Individual movements within the roundabout are anticipated to operate at LOS C or better during both peak hours.
- At the US 29 NB Ramp at Ivy Road roundabout, the overall LOS is expected to perform at LOS B and LOS A during the AM and PM peak hours, respectively. All individual movements within the roundabout are anticipated to operate at LOS B or better during both peak hours.

Old Ivy Road Shared Use Path South side: Pedestrian improvements can be summarized as follows:

- A 10-foot Shared Use Path is proposed for the south side of Old Ivy Road. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Old Ivy Road Intersection: Two final build alternatives were analyzed in the build conditions analysis – two-way (one-way at a time under the railroad bridge – advanced stop bar) and one-way westbound operation. The analysis results, presented in **Table 2-20** and **Table 2-21**, can be summarized as follows:

- The Old Ivy Road two-way traffic flow at Ivy Road with an advanced stop bar is forecast to operate with LOS C conditions during both peak hours. However, the northbound approach is projected to experience LOS D conditions during the AM and PM peak hours, and the southbound approach is forecast to experience LOS D during the PM peak hour. The traffic signal clearance interval for the southbound Old Ivy Road approach was adjusted to account for the stop bar being moved to the north side of the railroad (a distance of approximately 250 feet). This improvement includes a 5 or 6-foot raised sidewalk under the railroad bridge.
- The Old Ivy Road at Ivy Road one-way westbound alternative has a forecasted overall intersection LOS A during both peak hours. However, the northbound approach is projected to experience LOS D conditions during the PM peak hour.
- **Table 2-21** summarizes the forecasted impacts of the Old Ivy Road one-way alternative at the intersection of Ivy Road and Canterbury Road from rerouted traffic. The overall LOS is expected to perform at LOS E/F during the AM and PM peak hours, respectively. The eastbound left-turn movement is predicted to operate at LOS F during the AM peak hour. The westbound approach is projected to experience a poor LOS of F during the AM and PM peak hours. The southbound left-turn movement is forecast to operate at LOS D and LOS F during the AM and PM peak hours, respectively. Maximum queue lengths are forecasted

to exceed 1,400 feet on the southbound through/left movement in both peak hours, and the eastbound through movement is forecast to develop a 1,800-foot maximum queue in the AM peak hour. In summary, the Old Ivy Road one-way alternative negatively impacts operations at the intersection of Ivy Road and Canterbury Road through rerouted traffic, which would require mitigation to offset this impact.

Access Management Improvements (NB Bypass ramps to Colonnade Drive) can be summarized as follows:

- Install a raised median between the Bypass northbound ramp intersection and Colonnade Drive to prevent left turns through this segment and improve safety and operations.

Reed Lane, Stillfried Lane, and Colonnade Drive intersections: One improvement alternative was carried forward for build conditions analysis for these three study intersections – hybrid roundabouts. The analysis results, presented in **Table 2-22**, can be summarized as follows:

- At the Reed Lane at Ivy Road roundabout, the overall intersection LOS during the AM and PM peak hours is expected to be LOS A. All movements are projected to operate with LOS A conditions in both peak hours.
- At the Stillfried Lane at Ivy Road roundabout, the overall intersection LOS during both peak hours is expected to be LOS A. All movements are forecasted to operate with LOS A or B conditions.
- At the Colonnade Drive at Ivy Road roundabout, the overall intersection LOS during the AM and PM peak hours is projected to be LOS A. All movements are forecasted to operate with LOS A conditions during peak hours.

Table 2-9. Ivy Road – Ednam Drive 2035 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		Q
				AM	PM	AM	PM	
1	Ivy Rd at Ednam Dr- RIRO -Signalized-	EB	EBL/T	17.4	10.0	B	A	37
			EBR	5.2	5.5	A	A	14
		WB	WBL	12.8	1.4	B	A	10
			WBT	1.0	3.9	A	A	8
		NB	NBR	59.0	52.8	E	D	13
		OVERALL	12.0	10.0	B	A		
1	Ivy Rd at Ednam Dr – Green-T -Signalized-	EB	EBL/T	18.6	11.8	B	B	5
			EBR	3.8	3.9	A	A	1
		WB	WBL	58.0	65.5	E	E	1
			WBT	0.6	0.6	A	A	
		NB	NBL	60.4	53.6	E	D	
			NBR	48.8	38.6	D	D	1
OVERALL	14.9	10.0	B	A				

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

Table 2-10. Ivy Road – Farmington Drive 2035 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		B SIDRA /Qu
				AM	PM	AM	PM	
2	Ivy Rd at Farmington Dr -Roundabout-	EB	EBL	10.7	7.9	B	A	266
			EBT	10.5	8.1	B	A	266
			EBR	3.5	3.7	A	A	1.3
		WB	WBL	8.0	10.1	A	B	142
			WBT	7.6	10.2	A	B	142
			WBR	4.3	3.8	A	A	14.1
		NB	NBL	9.4	6.6	A	A	11.1
			NBL	9.4	6.6	A	A	11.1
			NBR	9.4	6.6	A	A	11.1
		SB	SBL	6.1	12.8	A	B	10.1
			SBT	6.1	12.0	A	B	10.1
			SBR	9.8	12.0	A	B	10.1
			OVERALL	8.9	9.3	A	A	
		2	Ivy Rd at Farmington Dr- RIRO -Signalized-	EB	EBL	1.0	16.2	A
EBR	4.9				6.1	A	A	13
EBT	6.3				8.2	A	A	14.1
WB	WBL			14.8	12.9	B	B	35
	WBR			5.8	7.9	A	A	38
	WBT			12.2	27.1	B	C	21.6
NB	NBT			62.8	56.9	E	E	0
	NBR			62.2	56.6	E	E	22
SB	SBT			60.0	53.6	E	D	64
	SBR			60.0	53.6	E	D	64
	OVERALL			10.2	20.7	B	C	

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

Table 2-11. Ivy Road - Boxwood Estate Road 2035 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		B SIDRA /Qu
				AM	PM	AM	PM	
3	Ivy Rd at Boxwood Estate Rd-RIRO -Unsignalized-	EB	EBT	0.0	0.0	A	A	0
		WB	WBR/T	0.0	0.0	A	A	0
		SB	SBR	16.1	26.6	C	D	5

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

Table 2-12. Ivy Road – Boars Head Drive 2035 Build Analysis Results

No.	Intersection	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		SIDRA Percent	
			AM	PM	AM	PM		
4	Ivy Rd at Boars Head Dr/Colridge Dr -Roundabout-	EBL	6.7	5.7	A	A	90	
		EBT	9.5	8.0	A	A	90	
		EBR	5.7	5.2	A	A	50	
		WBU	3.7	4.0	A	A	11	
		WBL	3.7	4.0	A	A	11	
		WBT	5.7	8.1	A	A	179	
		WBR	5.5	8.1	A	A	179	
		NBL/R/T	15.3	13.5	C	B	10	
		SBL/R/T	6.0	9.2	A	A	2	
			OVERALL	7.8	8.1	A	A	-

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

Table 2-13. Ivy Road – Canterbury Road 2035 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS			
				AM	PM	AM	PM		
				5	Ivy Rd at Canterbury Rd -Roundabout-	EB	EBL	6.8	6.4
EBT	6.4	5.9	A				A		
EBR	6.8	7.2	A				A		
WB	WBL	7.7	7.2			A	A		
	WBT	8.8	10.3			A	B		
	WBR	7.1	6.8			A	A		
NB	NBL	9.3	6.0			A	A		
	NBT	6.6	8.3			A	A		
	NBR	8.2	7.4			A	A		
SB	SBL	7.9	10.5			A	B		
	SBT	10.4	10.0			B	A		
	SBR	20.2	23.9			C	C		
OVERALL						10.1	11.8	B	B
5	Ivy Rd at Canterbury Rd – Dual SB Right Turn -Signalized-	EB	EBL			32.2	37.3	C	D
			EBR	8.6	8.2	A	A		
			EBT	15.8	12.6	B	B		
		WB	WBL	12.7	21.5	B	C		
			WBR/T	28.6	31.6	C	C		
		NB	NBL/T	57.0	62.0	E	E		
			NBR	54.9	60.1	D	E		
		SB	SBL/T	54.7	95.3	D	F		
			SBR	27.6	34.4	C	C		
		OVERALL				26.8	32.7	C	C

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

*HCM 2000 Methodology **SIDRA HCS Methodology (95th Percentile Queue)

Table 2-14. Triangle-about at Old Garth - 2030 Build Intersection Analysis Results

Intersection #1	Old Garth Rd EB Approach	US 29 SB Ramp WB Approach	Old Ivy Rd SEB Approach	Old Ivy Rd NWB Approach	Overall Intersection
AM PEAK HOUR					
LOS	A	A	F	n/a	E
Delay (sec/veh)	0.0	4.4	625.1	n/a	44.4
95th Percentile Queue (ft)	0 (EB R)	47 (WB L) 0 (WB TR)	321 (SE TR)	n/a	–
Distance to Nearest Upstream Intersection (ft)	240	420	3900	n/a	–
PM PEAK HOUR					
LOS	A	A	E	n/a	A
Delay (sec/veh)	0.0	2.5	35.7	n/a	3.1
95th Percentile Queue (ft)	0 (EB R)	22 (WB L) 0 (WB TR)	40 (SE TR)	n/a	–
Distance to Nearest Upstream Intersection (ft)	240	420	3900	n/a	–
Intersection #2	Old Ivy Rd EB Approach	Old Ivy Rd WB Approach	Driveway NB Approach	Faulconer Dr SB Approach	Overall Intersection
AM PEAK HOUR					
LOS	A	A	D	n/a	A
Delay (sec/veh)	1.0	0.0	30.6	n/a	1.0
95th Percentile Queue (ft)	10 (EB L) 0 (EB T) 0 (EB R)	0 (WB R)	1 (NB TR)	n/a	–
Distance to Nearest Upstream Intersection (ft)	340	350	n/a	n/a	–
PM PEAK HOUR					
LOS	A	A	C	n/a	A
Delay (sec/veh)	0.4	0.0	18.1	n/a	0.8
95th Percentile Queue (ft)	3 (EB L) 0 (EB T) 0 (EB R)	0 (WB R)	9 (NB TR)	n/a	–
Distance to Nearest Upstream Intersection (ft)	340	350	n/a	n/a	–
Intersection #3	US29 SB Off-Ramp WB Approach	Faulconer Dr NB Approach	Faulconer Dr SB Approach	Overall Intersection	
AM PEAK HOUR					
LOS	A	C **	E	B **	
Delay (sec/veh)	0.0	20.8 **	40.7	11.2 **	
95th Percentile Queue (ft)	0 (WB LT) 0 (WB R)	0 (NB L) 95 (NB T)	155 (SB R)	–	
Distance to Nearest Upstream Intersection (ft)	880*	410	1700	–	
PM PEAK HOUR					
LOS	A	A	C	A **	
Delay (sec/veh)	0.0	3.7 **	17.0	2.6 **	
95th Percentile Queue (ft)	0 (WB LT) 0 (WB R)	0 (NB L) 18 (NB T)	29 (SB R)	–	
Distance to Nearest Upstream Intersection (ft)	880*	410	1700	–	

* Approximate ramp storage capacity. If exceeded, vehicle queue extends onto mainline US 29.

** Calculated manually due to channelized NBL turn lane. Synchro/SimTraffic cannot model channelized left turns.

Table 2-15. Westbound Right at Old Ivy Road - 2035 Build US 29 HCS Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS	
				AM	PM	AM	PM
				6	Old Ivy Rd at US 29 NB Ramp – WB Channelized Right -Unsignalized-	EB	EBL
EBT	4.4	5.6	A				A
EBR	4.4	5.6	A				A
WB	WBL	0.0	0.0			A	A
	WBR	0.0	0.0			A	A
	WBT	0.0	0.0			A	A
NB	NBLTR	80.1	85.2			F	F

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

Table 2-17. Partial Cloverleaf at Ivy Road - 2035 Build US 29 HCS Analysis Results

	Type	# Lanes	Analyses	NB 2035		BI
				AM	PM	AM
Bypass NB On-Ramp at Ivy Road (loop ramp)	Merge	2	Density (D), pc/mi/ln	20.0	18.7	13.2
			Level of Service (LOS)	B	B	B
			Speed (mph)	50.6	50.6	51.5
			Input Volume (vph)	1,491	1,392	1,491
			Analyses	NB 2035		BI
				AM	PM	AM
Bypass SB Off-Ramp at Ivy Road (loop ramp)	Diverge	2	Density (D), pc/mi/ln	13.1	23.3	7.8
			Level of Service (LOS)	B	C	A
			Speed (mph)	46.7	46.7	46.7
			Input Volume (vph)	1,046	2,120	1,046

Table 2-16. North of Ivy Road Ramps - 2035 Build US 29 HCS Analysis Results

	Type	# Lanes	Analyses	NB 2035		BI
				AM	PM	AM
Bypass NB On-Ramp at Old Ivy Road	Merge	2	Density (D), pc/mi/ln	27.6	25.3	17.1
			Level of Service (LOS)	C	C	B
			Speed (mph)	50.1	50.1	50.6
			Input Volume (vph)	2,506	2,670	2,506
			Analyses	NB 2035		BI
				AM	PM	AM
Bypass SB Off-Ramp at Old Garth Road	Diverge	2	Density (D), pc/mi/ln	12	22.3	7.9
			Level of Service (LOS)	B	C	A
			Speed (mph)	46.1	46	46.1
			Input Volume (vph)	1,704	2,850	1,704

Table 2-18. South of Ivy Road Ramps - 2035 Build US 29 HCS Analysis Results

	Type	# Lanes	Analyses	NB 2035		BD 2035
				AM	PM	AM
Bypass NB Off-Ramp at Ivy Road	Diverge	2	Density (D), pc/mi/ln	15.4	14.4	12.1
			Level of Service (LOS)	B	B	B
			Speed (mph)	45.8	46.5	45.8
			Input Volume (vph)	2,327	1,723	2,327
			Analyses	NB 2035		BD 2035
				AM	PM	AM
Bypass SB On-Ramp at Ivy Road	Merge	2	Density (D), pc/mi/ln	11.2	25.2	7.0
			Level of Service (LOS)	B	C	A
			Speed (mph)	51.1	50.3	51.7
			Input Volume (vph)	1,040	2,542	1,040

Table 2-19. Ivy Road - 2035 Build Roundabout Analysis Results

Table 2-20. Ivy Road - 2035 Build at Old Ivy Road Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		BD 2035 Queue (ft.)
				AM	PM	AM	PM	AM
9	Ivy Rd at Old Ivy Rd/St Annes Dr - Two-way w/advanced stop bar -Signalized-	EB	EBL	13.1	14.0	B	B	89
			EBT	22.4	12.6	C	B	337
		WB	WBR	14.0	12.9	B	B	128
			WBT	14.9	26.4	B	C	128
		NB	NBL/R/T	39.9	51.3	D	D	20
		SB	SBL/R/T	32.6	49.7	C	D	214
	OVERALL		21.1	23.8	C	C		
9	Ivy Rd at Old Ivy Rd/St Annes Dr - One-way -Signalized-	EB	EBL	1.8	1.8	A	A	34
			EBT	3.6	2.3	A	A	64
		WB	WBR	2.0	2.1	A	A	16
			WBT	2.1	3.8	A	A	37
		NB	NBL/R/T	28.8	45.1	C	D	20
		SB	SBL/R/T	0.0	0.0	A	A	0
	OVERALL		3.0	3.4	A	A		

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

*HCM 2000 Methodology

Table 2-21. Ivy Road - 2035 Build at Canterbury Road Analysis Results (Old Ivy one-way impacts)

No.	Intersection	Approach	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		BD 2035 Queue (ft)
				AM	PM	AM	PM	AM
10	Ivy Rd at Canterbury Rd -Signalized-	EB	EBL	89.2	117.4	F	F	500
			EBR	18.1	17.2	B	B	286
			EBT	26.6	26.4	C	C	1,794
		WB	WBL	26.5	24.0	C	C	204
			WBR/T	134.8	105.7	F	F	638
		NB	NBL/T	62.0	67.1	E	E	100
			NBR	59.7	65.0	E	E	83
		SB	SBL/T	51.0	135.8	D	F	1,473
			SBR	27.8	38.1	C	D	65
		OVERALL				64.7	81.0	E

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

Table 2-22. Ivy Road - 2035 Build Roundabout Analysis Results

No.	Intersection	Lane Group	HCM BD 2035 Delay (sec/veh)		BD 2035 HCM LOS		SIDRA Percent
			AM	PM	AM	PM	AM
11	Ivy Rd at Reed Ln -Roundabout-	EBT	7.5	4.3	A	A	230.1
		EBR	7.2	4.2	A	A	230.1
		WBU	3.3	3.3	A	A	1
		WBL	3.3	3.3	A	A	1
		WBT	3.4	9.1	A	A	36.6
		NBL	5.8	3.9	A	A	1.5
		NBR	5.8	3.9	A	A	1.5
		OVERALL	6.4	7.8	A	A	-
12	Ivy Rd at Stillfried Ln -Roundabout-	EBT	12.1	5.2	B	A	238.4
		EBR	11.9	5.1	B	A	238.4
		WBU	3.5	8.7	A	A	35.4
		WBL	3.5	8.7	A	A	35.4
		WBT	3.9	8.3	A	A	35.4
		NBL	6.2	5.4	A	A	11.3
		NBR	6.7	5.6	A	A	11.3
OVERALL	9.7	7.2	A	A	-		
13	Ivy Rd at Colonnade Dr -Roundabout-	EBT	8.4	5.8	A	A	156
		EBR	9.1	6.1	A	A	156
		WBL	3.6	3.8	A	A	3.5
		WBT	3.9	8.6	A	A	33.9
		NBL	7.6	4.6	A	A	19.7
		NBR	6.5	5.8	A	A	19.7
OVERALL	7.1	7.4	A	A	-		

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

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. Analysis was conducted on the final improvement alternatives carried forward to the second public survey. **Appendix E** provides the *Synchro/SimTraffic* output reports. The *Synchro/SimTraffic* analysis results for the year 2045 build conditions, presented in **Table 2-23** through **Table 2-36**, indicate that:

Ednam Drive Intersection: Two improvement configurations were considered in the build conditions analysis – a right-in/right-out left-in configuration and a Green-T intersection. The analysis results, presented in **Table 2-23**, can be summarized as follows:

- The Ednam Drive right-in/right-out left-in alternative at Ivy Road is expected to perform at a LOS B during the AM and PM peak hours. However, the northbound right-turn movement is forecast to operate at LOS E and LOS D during the AM and PM peak hours, respectively.
- The Edman Drive Green-T alternative at Ivy Road is projected to operate with an overall intersection LOS B during the AM and PM peak hours. The westbound left turn movement is anticipated to operate at LOS E during both peak hours. In addition, the northbound left-turn movement is projected to operate at LOS E and LOS D during the AM and PM peak hours, respectively. The Green-T performs satisfactorily, but specific individual movements may experience moderate congestion.

Farmington Drive Intersection: Two final build alternatives were analyzed at the Farmington Drive intersection – a hybrid roundabout and a right-in/right-out and left-in intersection. The analysis results, presented in

Table 2-24, can be summarized as follows:

- At the Farmington Drive at Ivy Road roundabout, the forecasted LOS during both peak hours is expected to be LOS A. All individual movements are anticipated to perform at LOS B or better during both peak hours. In summary, the overall performance of this roundabout is excellent, with all movements experiencing efficient traffic flow.
- The Farmington Drive at Ivy Road right-in/right-out and left-in intersection is expected to operate at LOS B/C during the AM and PM peak hours, respectively. However, the northbound and southbound approaches are forecast to experience a poor LOS E during the AM and PM peak hours.

Boxwood Estate Road Intersection: Only one alternative was analyzed in the final build conditions – a right-in/right-out only intersection. The analysis results, presented in **Table 2-25**, can be summarized as follows:

- The Boxwood Estate Road right-in/right-out (RIRO) alternative at Ivy Road is expected to perform at LOS D or better for all the movements during both peak hours. Overall, the right-in/right-out performance is satisfactory, but the southbound movements may experience slightly higher delay.

Boxwood Estate Road and Boars Head Drive Access Management improvements can be summarized as follows:

- Installing a raised median between Boxwood Estate Road and Boars Head Drive at Ivy Road will manage traffic flow and provide comfortable left-hand turning pockets with fewer or narrower lanes. Another benefit of the raised median for two- and three-lane roads is the crossing island, which provides pedestrian refuge.

New Interparcel connection can be summarized as follows:

- Extend Kenridge Park Road to Weedon Professional Center entrance. This extension of the frontage road has right-of-way dedicated for this purpose. This frontage road extension provides more opportunities for access management options within its vicinity. No specific traffic analysis was conducted for this alternative.

Boars Head Drive Intersections: One improvement configuration was considered in the build conditions analysis – a hybrid roundabout. The analysis results, presented in **Table 2-26**, can be summarized as follows:

- At the Boars Head Drive at Ivy Road roundabout, the overall LOS during both peak hours is expected to be LOS A. Individual movements within the roundabout are anticipated to perform at LOS C or better during both peak hours.

Boars Head Drive and Canterbury Road Access Management Improvements can be summarized as follows:

- Installation of a raised median between Boars Head Drive and Canterbury Road on Ivy Road will prevent all left turns through this segment. This improvement would necessitate U-turns, which can be accommodated at the proposed Boars Head Drive roundabout.

Canterbury Road Intersection: Two improvement alternatives were considered in the build conditions analysis – a hybrid roundabout and southbound dual right turn lanes on Old Garth Road. The analysis results, presented in **Table 2-27**, can be summarized as follows:

- At the Canterbury Road at Ivy Road roundabout, the overall LOS during the AM and PM peak hours is expected to be LOS B. All individual movements within the roundabout are anticipated to perform at LOS C or better during both peak hours. In summary, the overall performance of this roundabout is sufficient, with all movements experiencing adequate traffic flow.
- Canterbury Road at Ivy Road Dual SB Right alternative at Ivy Road is expected to perform at LOS C/D during the AM and PM peak hours, respectively. Eastbound left turn movement is anticipated to operate at LOS D during the AM and PM peak hours. In addition, the northbound left-turn movement is forecast to operate at LOS E during the AM and PM peak hours. The southbound left-turn movement is expected to operate at LOS D and LOS F during the AM and PM peak hours, respectively. Eastbound through movement queues are forecast to reach a maximum length of 1,386 feet in the AM peak hour. The southbound through/left movement is estimated to produce maximum queues of over 1,320 feet in both peak hours, potentially impacting operations on the Bypass.

Triangle-about at Old Garth Intersection: The analysis results, presented in **Table 2-28**, can be summarized as follows:

- A previous traffic study conducted by ATCS recommended converting the existing Old Garth Road/Old Ivy Road area from two-way streets to one-way streets within an “intersection triangle” comprised of Old Garth Road, Old Ivy Road, and Faulconer Drive. Vehicles travel in a counterclockwise direction when viewed from above. These intersections function like a large roundabout, improving the flow of vehicles between intersections and into and out of the area. Future background traffic volume was estimated in the ATCS study by growing 2019 traffic volumes to the year 2030 following VDOT traffic forecasting guidance.
- Triangle-about Intersection #1 is located at Old Garth Road, US 29 SB Off-Ramp on Old Ivy Road; the overall intersection is forecast to operate with LOS E and LOS A conditions in the AM and PM peak hours, respectively.
- Triangle-about Intersection #2 is located at Faulconer Drive on Old Ivy Road; the overall intersection is forecast to operate with LOS A conditions during the AM and PM peak hours.

- Triangle-about Intersection #3 is located at Faulconer Drive on the US 29 SB Off-Ramp segment; the overall intersection is forecast to operate with LOS B and LOS A conditions in the AM and PM peak hours, respectively.

US 29 NB On-ramp at Old Ivy Road: The analysis results, presented in **Table 2-29**, can be summarized as follows:

- Install a channelized westbound right turn lane at Old Ivy Road unsignalized intersection to improve the eastbound through traffic flow to prevent significant queuing.
- The US 29/250 on-ramp alternative at Old Ivy Road is expected to perform at LOS A for all the movements during both peak hours. Overall, the eastbound and westbound performance is satisfactory, but the northbound movements may experience higher delays, which have LOS F during both peak hours (this is a very low volume movement).

Extend NB and SB US 29 Acceleration/Deceleration Lanes North of Ivy Road: The analysis results, presented in **Table 2-30**, can be summarized as follows:

- These improvements on the freeway interchange ramps can reduce congestion by creating specific areas for merging or diverging traffic to speed up and slow down to a safer speed to enter or exit the main flow of traffic on the Bypass. Moreover, these ramp improvements could reduce the stop-and-go effects and collisions caused by slower traffic at interchanges.
- The Old Ivy Road at US 29 NB On-Ramp merge segment is forecast to operate with LOS B conditions in the AM and PM peak hours. In summary, the overall acceleration lane performance is satisfactory; the build conditions improve on the No Build scenario, which has LOS C during the AM and PM peak hours.
- The Old Garth Road at US 29 SB Off-Ramp diverge segment is forecast to operate with LOS A and B conditions in the AM and PM peak hours, respectively. In summary, the overall deceleration lane performance is satisfactory; the build conditions improve on the No Build scenario, which has LOS B and C during the AM and PM peak hours, respectively.

Rebuild Ivy Road NB On-ramp and SB Off-ramp Standards: The analysis results, presented in **Table 2-31**, can be summarized as follows:

- These improvements include replacing and widening the 3 bridges over US 29 to accommodate the proposed 6 lanes between Leonard Sandridge Road and Ivy Road. Bridge replacement would allow sufficient width to install standard-length acceleration and deceleration lanes beneath the bridge. Additionally, these improvements include reconstructing the railroad with two tracks to allow the replacement of overpass bridges while maintaining railroad operation.
- The Ivy Road at US 29 NB On-Ramp merge segment is forecast to operate with LOS B conditions in the AM and PM peak hours. In summary, the overall acceleration lane

performance is satisfactory; the build conditions improve on the No Build scenario (shown in), which has LOS C and B during the AM and PM peak hours, respectively.

- The Ivy Road at US 29 SB Off-Ramp diverge segment is forecast to operate with LOS A and B conditions in the AM and PM peak hours, respectively. In summary, the overall deceleration lane performance is satisfactory; the build conditions improve on the No Build scenario, which has LOS B and C during the AM and PM peak hours, respectively.

Extend US 29 NB Off-ramp and SB On-ramp South of Ivy Road: The analysis results, presented in **Table 2-32**, can be summarized as follows:

- These improvements on the freeway interchange directional ramps can reduce congestion by creating specific areas for merging or diverging traffic to speed up and slow down to a safer speed to enter or exit the main flow of traffic on the Bypass. Moreover, these ramp improvements could reduce the stop-and-go effects and collisions caused by slower traffic at interchanges.
- The Ivy Road at US 29 NB Off-Ramp diverge segment is forecast to operate in the AM and PM peak hours with LOS B conditions. In summary, the overall deceleration lane performance is satisfactory; the build conditions show minor improvement over the density of the No Build scenario (approximately 3 pc/mi/ln).
- The Ivy Road at US 29 SB On Ramp merge segment is forecast to operate with LOS A and C conditions in the AM and PM peak hours, respectively. In summary, the overall acceleration lane performance is satisfactory; the build conditions show minor improvement over the density of the No Build scenario (approximately 4 pc/mi/ln).

US 29/US 250 Ramp Terminals: One improvement configuration was considered in the build conditions analysis for the Ivy Road ramp terminals – hybrid roundabouts. The analysis results, presented in **Table 2-33**, can be summarized as follows:

- The US 29 SB Ramp at Ivy Road roundabout, the overall LOS is expected to perform at LOS A/B during the AM and PM peak hours, respectively. Individual movements within the roundabout are also expected to perform well, 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 US 29 NB Ramp at Ivy Road roundabout, the overall LOS is expected to perform at LOS B/A during the AM and PM peak hours, respectively. Individual movements within the roundabout are also expected to perform well, 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.

Old Ivy Road Intersection: Two final build alternatives were analyzed in the build conditions analysis – two-way (one-way at a time under the railroad bridge – advanced stop bar) and one-way westbound operation. The analysis results, presented in **Table 2-34** and **Table 2-35**, can be summarized as follows:

- The Old Ivy Road two-way westbound traffic flow at Ivy Road is two-way, and the overall LOS during the AM and PM peak hours is expected to be LOS C. However, the northbound approach is forecast to experience a poor LOS D during the AM and PM peak hours, and the SB approach is forecast to experience LOS E conditions during the PM peak hour.
- Pedestrian improvements (a 5 or 6-foot raised sidewalk) are proposed with the two-way intersection improvement at Old Ivy Road.
- The second build alternative is the one-way westbound-only traffic flow at Old Ivy Road and a raised 6-foot sidewalk. The forecasted overall intersection LOS during the AM and PM peak hours is expected to be LOS A. However, the northbound approach is forecast to experience a poor LOS of E during the PM peak hour. In summary, the overall performance of this alternative is sufficient, with most movements experiencing efficient traffic flow.
- In the one-way westbound Old Ivy Road alternative, traffic is rerouted to Old Garth Road, and the overall Level of Service (LOS) is expected to perform at LOS F/E during the AM and PM peak hours, respectively. During the AM peak hour, the eastbound left-turn movement is forecast to operate at LOS F. The westbound approach is forecast to experience poor LOS F conditions during the AM and PM peak hours. The southbound left-turn movement is anticipated to operate at LOS D and LOS F during the AM and PM peak hours, respectively, with PM queues exceeding 1,400 feet in length. Eastbound and westbound queueing is very long on the Ivy Road approaches, exceeding 600 feet in both peak hours. In summary, the overall performance of the intersection is insufficient.

Old Ivy Road Shared Use Path South side: Pedestrian improvements can be summarized as follows:

- A 10-foot Shared Use Path is proposed for the south side of Old Ivy Road. Additionally, pedestrian crosswalks are proposed for all the side street intersections where they are not presently installed.

Access Management Improvements (NB Bypass ramps to Colonnade Drive) can be summarized as follows:

- Install a raised median between the Bypass northbound ramp intersection and Colonnade Drive to prevent left turns through this segment and improve safety and operations.

Roundabouts at Reed Lane, Stillfried Lane, and Colonnade Drive: One improvement alternative was carried forward for build conditions analysis for these three study intersections – hybrid roundabouts. The analysis results, presented in **Table 2-36**, can be summarized as follows:

- At the Reed Lane at Ivy Road roundabout, the overall LOS during the AM and PM peak hours is expected to be LOS B. Individual movements within the roundabout are also anticipated to perform well, operating at LOS B or better during both peak hours. In summary, the overall performance of this roundabout is sufficient, with all movements experiencing efficient traffic flow.

- At the Stillfried Lane at Ivy Road roundabout, the overall intersection is expected to operate at LOS B/A during the AM and PM peak hours, respectively. In summary, this roundabout's overall performance is sufficient, with all movements experiencing efficient traffic flow.
- LOS A conditions are forecast for the overall intersection of Colonnade Drive at Ivy Road roundabout during both peak hours. Individual movements within the roundabout are also anticipated to perform well, operating at LOS B or better during both peak hours. In summary, the overall performance of this roundabout is sufficient, with all movements experiencing efficient traffic flow.

Table 2-23. Ivy Road – Ednam Drive 2045 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		Q
				AM	PM	AM	PM	
1	Ivy Rd at Ednam Dr- RIRO -Signalized-	EB	EBL/T	19.3	10.4	B	B	50
			EBR	5.2	5.6	A	A	17
		WB	WBL	25.7	1.3	C	A	17
			WBT	1.0	4.4	A	A	17
		NB	NBR	59.0	52.8	E	D	17
OVERALL	13.7	10.3	B	B				
1	Ivy Rd at Ednam Dr – Green - T -Signalized-	EB	EBL/T	21.2	12.3	C	B	5
			EBR	3.8	4.0	A	A	2
		WB	WBL	59.7	65.9	E	E	1
			WBT	0.6	0.6	A	A	1
		NB	NBL	60.4	53.7	E	D	1
NBR	48.7		38.6	D	D	9		
OVERALL	16.3	10.2	B	B				

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

Table 2-24. Ivy Road - Farmington Drive 2045 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		B SIDRA /Queue Max
				AM	PM	AM	PM	
2	Ivy Rd at Farmington Dr -Roundabout-	EB	EBL	11.7	8.5	B	A	315
			EBT	11.5	8.6	B	A	315
			EBR	3.5	3.7	A	A	1.3
		WB	WBL	8.4	10.9	A	B	158
			WBT	8.0	11.0	A	B	158
			WBR	4.4	3.8	A	A	15.1
		NB	NBL	10.8	7.0	B	A	14.1
			NBL	10.8	7.0	B	A	14.1
			NBR	10.8	7.0	B	A	14.1
		SB	SBL	6.6	14.6	A	B	11.1
			SBT	6.6	13.7	A	B	11.1
			SBR	10.5	13.7	B	B	11.1
	OVERALL	9.6	10.0	A	A			
2	Ivy Rd at Farmington Dr- RIRO -Signalized-	EB	EBL	0.9	19.2	A	B	44
			EBR	4.6	5.4	A	A	10
			EBT	6.2	7.5	A	A	146
		WB	WBL	17.4	12.6	B	B	46
			WBR	5.6	7.2	A	A	86
			WBT	12.3	27.0	B	C	169
		NB	NBT	62.8	56.9	E	E	0
			NBR	62.3	56.6	E	E	71
		SB	SBT	60.0	53.7	E	D	0
			SBR	60.0	53.7	E	D	72
			OVERALL	10.2	20.4	B	C	

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

Table 2-25. Ivy Road - Boxwood Estate Road 2045 Build Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		BD 2045 Queue Max
				AM	PM	AM	PM	
3	Ivy Rd at Boxwood Estate Rd- RIRO -Unsignalized-	EB	EBT	0.0	0.1	A	A	0
		WB	WBR/T	0.0	0.0	A	A	0
		SB	SBR	17.1	30.3	C	D	35

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

Table 2-26. Ivy Road - Boars Head Drive 2045 Build Analysis Results

No.	Intersection	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		SIDRA Percent	
			AM	PM	AM	PM		
4	Ivy Rd at Boars Head Dr/Colridge Dr -Roundabout-	EBL	7.9	6.8	A	A	105	
		EBT	11.5	9.8	B	A	105	
		EBR	6.5	6.1	A	A	57	
		WBU	4.1	4.9	A	A	23	
		WBL	4.1	4.9	A	A	23	
		WBT	6.1	8.8	A	A	194	
		WBR	5.8	8.7	A	A	194	
		NBL/R/T	19.5	17.0	C	C	13	
		SBL/R/T	6.3	10.4	A	B	2	
			OVERALL	8.9	9.1	A	A	-

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

Table 2-27. Ivy Road - Canterbury Road 2045 Build Analysis Results

Table 2-28. Triangle-about at Old Garth- 2030 Build Intersection Analysis Results

Intersection #1	Old Garth Rd EB Approach	US 29 SB Ramp WB Approach	Old Ivy Rd SEB Approach	Old Ivy Rd NWB Approach	Overall Intersection
AM PEAK HOUR					
LOS	A	A	F	n/a	E
Delay (sec/veh)	0.0	4.4	625.1	n/a	44.4
95th Percentile Queue (ft)	0 (EB R)	47 (WB L) 0 (WB TR)	321 (SE TR)	n/a	—
Distance to Nearest Upstream Intersection (ft)	240	420	3900	n/a	—
PM PEAK HOUR					
LOS	A	A	E	n/a	A
Delay (sec/veh)	0.0	2.5	35.7	n/a	3.1
95th Percentile Queue (ft)	0 (EB R)	22 (WB L) 0 (WB TR)	40 (SE TR)	n/a	—
Distance to Nearest Upstream Intersection (ft)	240	420	3900	n/a	—
Intersection #2	Old Ivy Rd EB Approach	Old Ivy Rd WB Approach	Driveway NB Approach	Faulconer Dr SB Approach	Overall Intersection
AM PEAK HOUR					
LOS	A	A	D	n/a	A
Delay (sec/veh)	1.0	0.0	30.6	n/a	1.0
95th Percentile Queue (ft)	10 (EB L) 0 (EB T) 0 (EB R)	0 (WB R)	1 (NB TR)	n/a	—
Distance to Nearest Upstream Intersection (ft)	340	350	n/a	n/a	—
PM PEAK HOUR					
LOS	A	A	C	n/a	A
Delay (sec/veh)	0.4	0.0	18.1	n/a	0.8
95th Percentile Queue (ft)	3 (EB L) 0 (EB T) 0 (EB R)	0 (WB R)	9 (NB TR)	n/a	—
Distance to Nearest Upstream Intersection (ft)	340	350	n/a	n/a	—
Intersection #3	US29 SB Off-Ramp WB Approach	Faulconer Dr NB Approach	Faulconer Dr SB Approach	Overall Intersection	
AM PEAK HOUR					
LOS	A	C **	E	B **	
Delay (sec/veh)	0.0	20.8 **	40.7	11.2 **	
95th Percentile Queue (ft)	0 (WB LT) 0 (WB R)	0 (NB L) 95 (NB T)	155 (SB R)	—	
Distance to Nearest Upstream Intersection (ft)	880*	410	1700	—	
PM PEAK HOUR					
LOS	A	A	C	A **	
Delay (sec/veh)	0.0	3.7 **	17.0	2.6 **	
95th Percentile Queue (ft)	0 (WB LT) 0 (WB R)	0 (NB L) 18 (NB T)	29 (SB R)	—	
Distance to Nearest Upstream Intersection (ft)	880*	410	1700	—	

* Approximate ramp storage capacity. If exceeded, vehicle queue extends onto mainline US 29.

** Calculated manually due to channelized NBL turn lane. Synchro/SimTraffic cannot model channelized left turns.

Table 2-29. Westbound Right at Old Ivy Road - 2045 Build Analysis Results

Table 2-30. North of Ivy Road Ramps - 2045 Build US 29 HCS Analysis Results

	Type	# Lanes	Analyses	NB 2045		BD 20
				AM	PM	AM
Bypass NB On-Ramp at Old Ivy Road	Merge	2	Density (D), pc/mi/ln	27.0	26.8	18.5
			Level of Service (LOS)	C	C	B
			Speed (mph)	49.9	50	50.5
			Input Volume (vph)	2,678	2,670	2,678
			Analyses	NB 2045		BD 20
Bypass SB Off-Ramp at Old Garth Road	Diverge	2	Density (D), pc/mi/ln	12.7	23.6	8.5
			Level of Service (LOS)	B	C	A
			Speed (mph)	46	45.9	46
			Input Volume (vph)	1,822	3,046	1,822

Table 2-31. Partial Cloverleaf at Ivy Road - 2045 Build US 29 HCS Analysis Results

	Type	# Lanes	Analyses	NB 2045		BD 2045
				AM	PM	AM
Bypass NB On-Ramp at Ivy Road	Merge	2	Density (D), pc/mi/ln	21.0	19.7	12.0
			Level of Service (LOS)	C	B	B
			Speed (mph)	50.5	50.6	51.8
			Input Volume (vph)	1,612	1,496	1,612
			Analyses	NB 2045		BD 2045
				AM	PM	AM
Bypass SB Off-Ramp at Ivy Road	Diverge	2	Density (D), pc/mi/ln	13.8	24.7	8.5
			Level of Service (LOS)	B	C	A
			Speed (mph)	46.7	46.7	46.7
			Input Volume (vph)	1,119	2,266	1,119

Table 2-32. South of Ivy Road Ramps - 2045 Build US 29 HCS Analysis Results

	Type	# Lanes	Analyses	NB 2045		BD 2045
				AM	PM	AM
Bypass NB Ramp at Ivy Road	Diverge	2	Density (D), pc/mi/ln	16.5	15.4	13.2
			Level of Service (LOS)	B	B	B
			Speed (mph)	45.8	46.5	45.8
			Input Volume (vph)	2,487	1,842	2,487
			Analyses	NB 2045		BD 2045
				AM	PM	AM
Bypass SB Ramp at Ivy Road	Merge	2	Density (D), pc/mi/ln	11.8	24.8	7.6
			Level of Service (LOS)	B	C	A
			Speed (mph)	51.1	50.4	51.7
			Input Volume (vph)	1,111	2,621	1,111

Table 2-33. Ivy Road - 2045 Build Roundabout Analysis Results

No.	Intersection	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		SIDRA Percent
			AM	PM	AM	PM	
			AM	PM	AM	PM	
7	Ivy Rd at US 29 SB Ramp -Roundabout-	EBR	12.7	39.6	B	D	189.2
		EBT	12.7	39.9	B	D	189.2
		WBU	2.8	0.0	A	A	10.2
		WBL	2.9	5.9	A	A	10.2
		WBT	0.0	0.1	A	A	0
		NBL	8.4	5.6	A	A	36.7
		NBR	7.1	5.6	A	A	36.7
		OVERALL	7.0	15.0	A	B	-
8	Ivy Rd at US 29 NB Ramp -Roundabout-	EBR	10.0	6.6	A	A	154.6
		EBT	17.0	10.5	B	B	154.6
		WBL	6.3	8.5	A	A	32.2
		WBT	5.6	8.0	A	A	32.2
		NBL	8.3	4.6	A	A	86.8
		NBR	18.3	8.7	B	A	126.3
		OVERALL	12.6	8.0	B	A	-

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

**SIDRA HCS Methodology

Table 2-34. Ivy Road - 2045 Build Two-way at Ivy Road Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		BD 2045 Queue (ft)
				AM	PM	AM	PM	
9	Ivy Rd at Old Ivy Rd/St Annes Dr - Two-way w/advanced stop bar -Signalized-	EB	EBL	13.0	13.8	B	B	89
			EBT	22.9	12.2	C	B	366
		WB	WBR	13.9	12.3	B	B	140
			WBT	14.8	26.2	B	C	140
		NB	NBL/R/T	41.4	54.7	D	D	20
		SB	SBL/R/T	34.3	59.0	C	E	216
OVERALL			21.5	24.6	C	C		
9	Ivy Rd at Old Ivy Rd/St Annes Dr - One-way -Signalized-	EB	EBL	1.8	1.7	A	A	23
			EBT	3.8	2.2	A	A	31
		WB	WBR	2.0	2.0	A	A	16
			WBT	2.1	4.0	A	A	25
		NB	NBL/R/T	29.1	64.7	C	E	16
		SB	SBL/R/T	0.0	0.0	A	A	0
OVERALL			3.1	3.5	A	A		

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

Table 2-35. Ivy Road - 2045 Build One-way at Ivy Road Analysis Results

No.	Intersection	Approach	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		BD 2045 Queue (ft)
				AM	PM	AM	PM	
10	Ivy Rd at Canterbury Rd -Signalized-	EB	EBL	124.3	51.6	F	D	1
			EBR	18.5	11.6	B	B	3
			EBT	42.2	18.2	D	B	207
		WB	WBL	23.4	21.0	C	C	35
			WBR/T	194.8	108.1	F	F	641
		NB	NBL/T	56.9	62.0	E	E	145
			NBR	54.8	60.1	D	E	29
		SB	SBL/T	44.1	228.2	D	F	0
			SBR	26.5	42.9	C	D	0
OVERALL			86.8	79.2	F	E		

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

Table

2-36. Ivy Road - 2045 Build Roundabout Analysis Results

No.	Intersection	Lane Group	HCM BD 2045 Delay (sec/veh)		BD 2045 HCM LOS		SIDRA Percent
			AM	PM	AM	PM	AM
11	Ivy Rd at Reed Ln -Roundabout-	EBT	13.4	5.6	B	A	267.3
		EBR	13.4	5.6	B	A	267.3
		WBU	3.3	3.3	A	A	1
		WBL	3.3	3.3	A	A	1
		WBT	4.0	12.5	A	B	39.1
		NBL	6.1	4.0	A	A	1.6
		NBR	6.1	4.0	A	A	1.6
		OVERALL	11.0	10.5	B	B	-
12	Ivy Rd at Stillfried Ln -Roundabout-	EBT	15.2	5.8	C	A	277.6
		EBR	13.8	5.8	B	A	277.6
		WBU	4.0	10.0	A	A	37.8
		WBL	4.0	10.0	A	A	37.8
		WBT	4.1	9.3	A	A	37.8
		NBL	6.8	5.7	A	A	12.6
		NBR	6.9	5.8	A	A	12.6
		OVERALL	12.0	8.0	B	A	-
13	Ivy Rd at Colonnade Dr -Roundabout-	EBT	10.6	6.3	B	A	175
		EBR	10.8	6.4	B	A	175
		WBL	3.7	3.9	A	A	3.8
		WBT	4.1	9.9	A	A	36
		NBL	7.5	5.0	A	A	22
		NBR	7.1	5.5	A	A	22
		OVERALL	8.6	8.4	A	A	-

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

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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 2-37** through **Table 2-48** indicate that:

- The Ivy Road at Ednam Road intersection is expected to operate slightly better as a Continuous Green-T 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 2-37**.
- The Ivy Road at Farmington Drive intersection is projected to operate slightly better as a Thru-Cut than a conventional roadway with fewer conflict points. The results are presented in **Table 2-38**.
- The Ivy Road at Boxwood Estate Road intersection is anticipated to operate slightly better as a two-way stop control roadway than a Continuous Green-T; however, the Continuous Green-T has fewer conflict points. The results are presented in **Table 2-39**.
- The Ivy Road at Boars Head Drive intersection is expected to operate much better as a roundabout than a conventional roadway. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a two-way stop control intersection. The results are presented in **Table 2-40**.
- The Ivy Road at Canterbury Road intersection is predicted to operate better as a roundabout than a conventional intersection in the PM peak hour. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) when compared to a conventional intersection. The other alternative (dual right-turn SBR) has the same number of weighted conflict points (48 vs. 48) as the existing un-signalized intersection with slightly better operations. The results are presented in **Table 2-41**.
- The Ivy Road at the SB US 29 Ramps intersection is projected to operate about the same as a Continuous Green-T compared to a conventional roadway. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a conventional intersection with higher V/C ratios. The results are presented in **Table 2-42**.
- The Ivy Road at the NB US 29 Ramp intersection is expected to operate about the same as a Continuous Green-T compared to a conventional roadway in the AM peak hour and better in the PM peak hour. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a conventional intersection with higher V/C ratios. The results are presented in **Table 2-43**.
- The Ivy Road at Reed Road intersection is expected to operate better as a two-way stop-controlled intersection than a roundabout. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a two-way stop control intersection. The results are presented in **Table 2-44**.

- The Ivy Road at Stillfried Lane intersection is expected to operate much better as a Continuous Green-T than as a two-way stop control roadway during the PM peak hour. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a two-way stop control intersection with slightly higher V/C ratios. The results are presented in **Table 2-45**.
- The Ivy Road at Colonnade Drive intersection is expected to operate better as a two-way stop control intersection than as a roundabout. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a two-way stop control intersection. The results are presented in **Table 2-46**.
- The Ivy Road at Alderman Road intersection is expected to operate better as a two-way stop control intersection than as a roundabout. The roundabout configuration offers a much lower total number of weighted conflict points (8 vs. 48) compared to a two-way stop control intersection. The results are presented in **Table 2-47**.

Table 2-37 Ivy Road at Ednam Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Conflict Points
AM	Conventional	-	0.68		
	Continuous Green-T	-	0.68	-	
	Roundabout	-	0.80		
PM	Conventional	-	0.64		
	Continuous Green-T	-	0.59	-	
	Roundabout	-	0.76		

Table 2-38 Ivy Road at Farmington Drive VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Conflict Points
AM	Conventional	-	0.62		
	Thru Cut	-	0.62		
PM	Conventional	-	0.69		
	Thru Cut	-	0.66		

Table 2-39 Ivy Road at Boxwood Estate Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Conflict Points
AM	Continuous Green-T	-	0.62	-	
	Two-Way Stop Control	-	0.45		
PM	Continuous Green-T	-	0.64	-	
	Two-Way Stop Control	-	0.56		

Table 2-40 Ivy Road at Boars Head Drive VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Conflict Points
AM	Roundabout	-	0.78		8
	Two-Way Stop Control	-	0.54		48
PM	Roundabout	-	0.83		8
	Two-Way Stop Control	-	0.56		48

Table 2-41 Ivy Road at Canterbury Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weight Total Co Point
AM	Conventional	-	0.69		48
	Dual Right-Turn SBR	-	0.65		48
	Roundabout	-	0.81		8
PM	Conventional	-	0.77		48
	Dual Right-Turn SBR	-	0.68		48
	Roundabout	-	0.71		8

Table 2-43 Ivy Road at NB Ramp - US 29 VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weight Total Co Point
AM	Conventional	-	0.44		48
	Continuous Green- T	-	0.44	-	12
	Roundabout	-	0.45		8
PM	Conventional	-	0.41		48
	Continuous Green- T	-	0.29	-	12
	Roundabout	-	0.88		8

Table 2-42 Ivy Road at SB Ramp - US 29 VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weight Total Co Point
AM	Conventional	-	0.35		48
	Continuous Green- T	-	0.34	-	12
	Roundabout	-	0.46		8
PM	Conventional	-	0.48		48
	Continuous Green- T	-	0.48	-	12
	Roundabout	-	0.85		8

Table 2-44 Ivy Road at Reed Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weight Total Co Point
AM	Roundabout	-	0.61		8
	Two-Way Stop Control	-	0.44		48
PM	Roundabout	-	0.74		8
	Two-Way Stop Control	-	0.55		48

Table 2-45 Ivy Road at Stillfried Lane VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weight Total Co Point
AM	Two-Way Stop Control	-	0.37		48
	Continuous Green- T	-	0.47	-	12
	Roundabout	-	0.62		8
PM	Two-Way Stop Control	-	0.60		48
	Continuous Green- T	-	0.07	-	12
	Roundabout	-	0.73		8

Table 2-46 Ivy Road at Colonnade Drive VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Cost Point
AM	Roundabout	-	0.52		8
	Two-Way Stop Control	-	0.36		48
PM	Roundabout	-	0.67		8
	Two-Way Stop Control	-	0.45		48

Table 2-47 Ivy Road at Alderman Road VJuST Analysis Results

Peak Hour	Type	Dir	Maximum V/C	Pedestrian Accommodation Compared to Conventional	Weighted Total Cost Point
AM	Conventional	-	0.52		48
	Roundabout	-	0.61		8
PM	Conventional	-	0.55		48
	Roundabout	-	0.72		8

Build Concepts & Cost Estimate

The build concepts contain a variety of proposed intersection improvements for many of the study area intersections and the US 29/250 interchange. Intersection improvements include roundabouts, access management, pedestrian accommodations, and interchange modifications.

The following concepts were evaluated as future build alternatives:

- **Concept 1** - The Ednam Drive Intersection is proposed to be reconfigured as a right-in/right-out left-in alternative and a Green-T. The layout for Concept 1 is presented in **Figure 2-1** and **Figure 2-2**.
- **Concept 2** – Two final build alternatives were proposed at the Farmington Drive intersection – a hybrid roundabout and a right-in/right-out and left-in intersection. The layout for Concept 2 is presented in **Figure 2-3**.
- **Concept 3** – The Boxwood Estate Road Intersection is proposed to be reconfigured as a right-in/right-out left-in with access management improvements. The layout for Concept 3 is presented in **Figure 2-4**.
- **Concept 4** – The Boars Head Drive Intersections is proposed to be a hybrid roundabout and Installed or raised Median between Boars Head Drive and Canterbury Road on Ivy Road to prevent all left turns through this segment. The layout for Concept 4 is presented in **Figure 2-5**.
- **Concept 5** – Installation of a raised median between Boars Head Drive and Canterbury Road to prevent left turns. This concept is envisioned to be coupled with the proposed roundabouts at Boars Head Drive and Canterbury Road to facilitate U-turn movements. This concept is partially shown in **Figure 2-5** and **Figure 2-6**.
- **Concept 6** – The Canterbury Road Intersection at Ivy Road, two improvement alternatives were proposed - a hybrid roundabout and southbound dual right turn lanes. The layout for Concept 5 is presented in **Figure 2-6** and **Figure 2-7**.
- **Concept 7** - The Old Garth Road at Old Ivy Road intersection is proposed as a Triangle-about. The layout for Concept 6 is presented in **Figure 2-8**.
- **Concept 8** – The extension of acceleration and deceleration lanes was proposed for the NB/SB ramps on US 29/250 located on the north side of Ivy Road. The layout for Concept 7 is presented in **Figure 2-9**.
- **Concept 9** – Replacing and widening the three bridges over US 29/250 to accommodate the proposed six lanes between Leonard Sandridge Road and Ivy Road. The layout for Concept 8 is presented in **Figure 2-10**.
- **Concept 10** – The extension of acceleration and deceleration lanes was proposed for the NB/SB ramps on US 29/250 located on the south side of Ivy Road. The layout for Concept 9 is presented in **Figure 2-11**.

- **Concept 11** – The US 29/250 ramp terminal intersections are proposed to be reconfigured with hybrid roundabouts. The layout for Concept 10 is presented in **Figure 2-12**.
- **Concept 12** – The Old Ivy Road intersection with Ivy Road is proposed as a controlled two-way traffic flow at the Ivy Road railroad bridge underpass (advance stop bar). The layout for Concept 11 is presented in **Figure 2-13**.
- **Concept 13** – The Old Ivy Road intersection is proposed as a one-way westbound traffic flow at Old Ivy Road with a raised 6 ft sidewalk. The layout for Concept 12 is presented in **Figure 2-14**.
- **Concept 14** – Pedestrian improvement (10-foot Shared Use Path) is proposed for the south side of Old Ivy Road. The layout for Concept 13 is presented in **Figure 2-15** to **Figure 2-17**.
- **Concept 15** – Roundabouts were proposed to be reconfigured at the intersections of Reed Lane, Stillfried Lane, and Colonnade Drive. The layout for Concept 14 is presented in **Figure 2-18**.

Cost estimates were prepared for the short-term Build concepts utilizing the 2021 VDOT Cost Estimating Manual methodologies and are presented in **Table 2-48**. **Table 2-48** displays the estimated cost in 2025 dollars; **Appendix G** also provides cost estimates based on future funding, with preliminary engineering beginning in January 2029 and construction beginning in July 2032. The short-term concepts are the higher-priority mitigation projects that may be pursued over the next 5-10 years. Details of these estimates are provided in **Appendix G**. Pedestrian improvements in the vicinity of intersections have been incorporated into the cost of the intersection improvements.

Table 2-48 – Ivy Road Short-Term Build Concept Cost Estimates (Year 2025 Cost)

Concept	Construction Contract	Preliminary Engineering	Right of Way	Total Estimated Project Cost (Year 2025)
4	\$5,604,560	\$1,609,400	\$984,000	\$8,197,960
5	\$883,350	\$331,200	\$0	\$1,214,550
6 (roundabout)	\$7,168,123	\$1,649,700	\$1,814,600	\$10,632,423
7	\$1,392,320	\$519,600	\$0	\$1,911,920
8 (SB ramp)	\$1,532,320	\$621,400	\$0	\$2,153,720
8 (NB ramp)	\$2,554,390	\$956,400	\$0	\$3,510,790

12	\$1,593,884	\$598,000	\$0	\$2,192,684
14	\$6,389,135	\$1,436,250	\$1,509,600	\$9,334,985

Figure 2-1 Ivy Road – Layout for Ednam Drive Intersection – Right-in/Right-out/Left-in

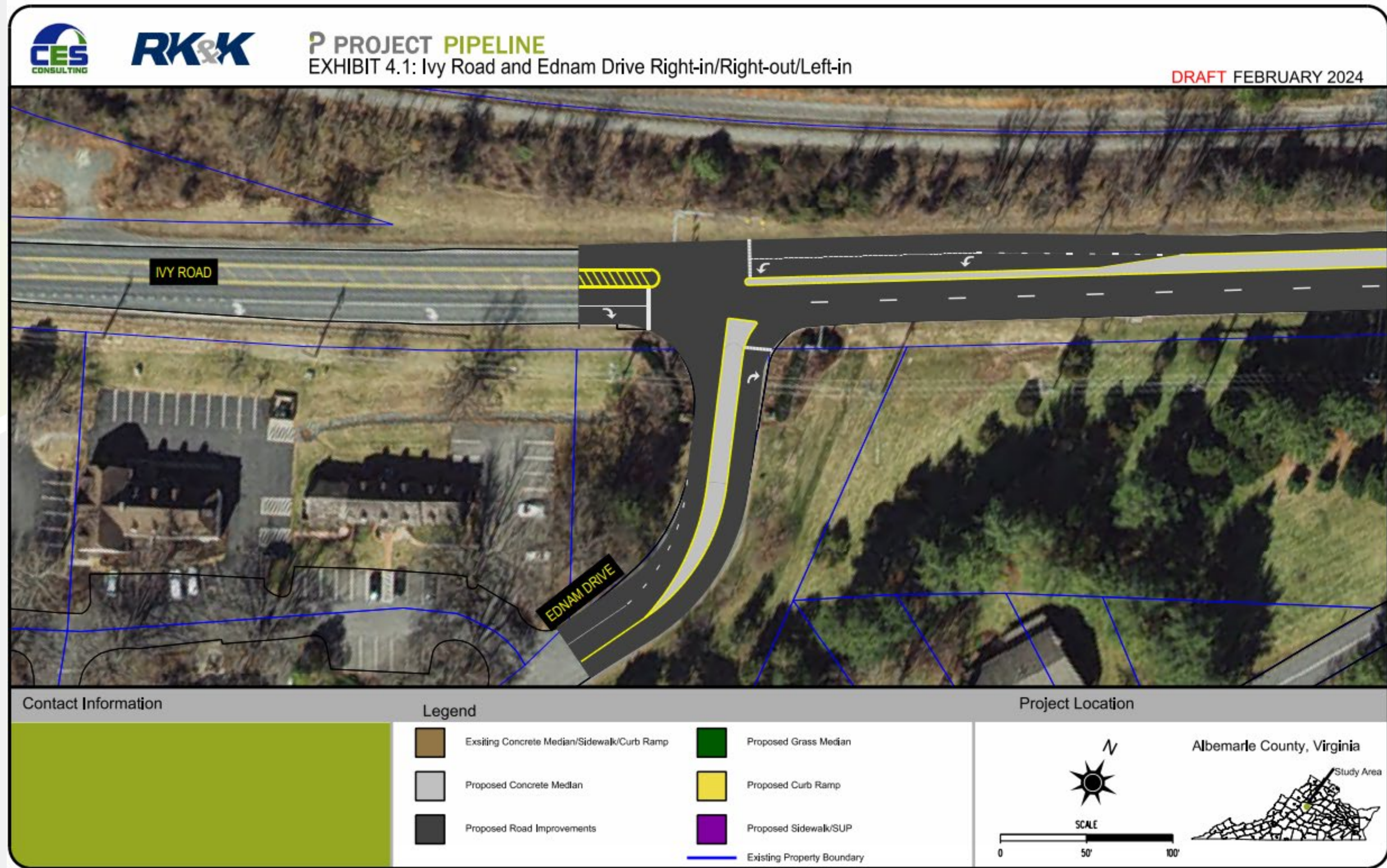


Figure 2-2 Ivy Road – Layout for Ednam Drive – Green-T

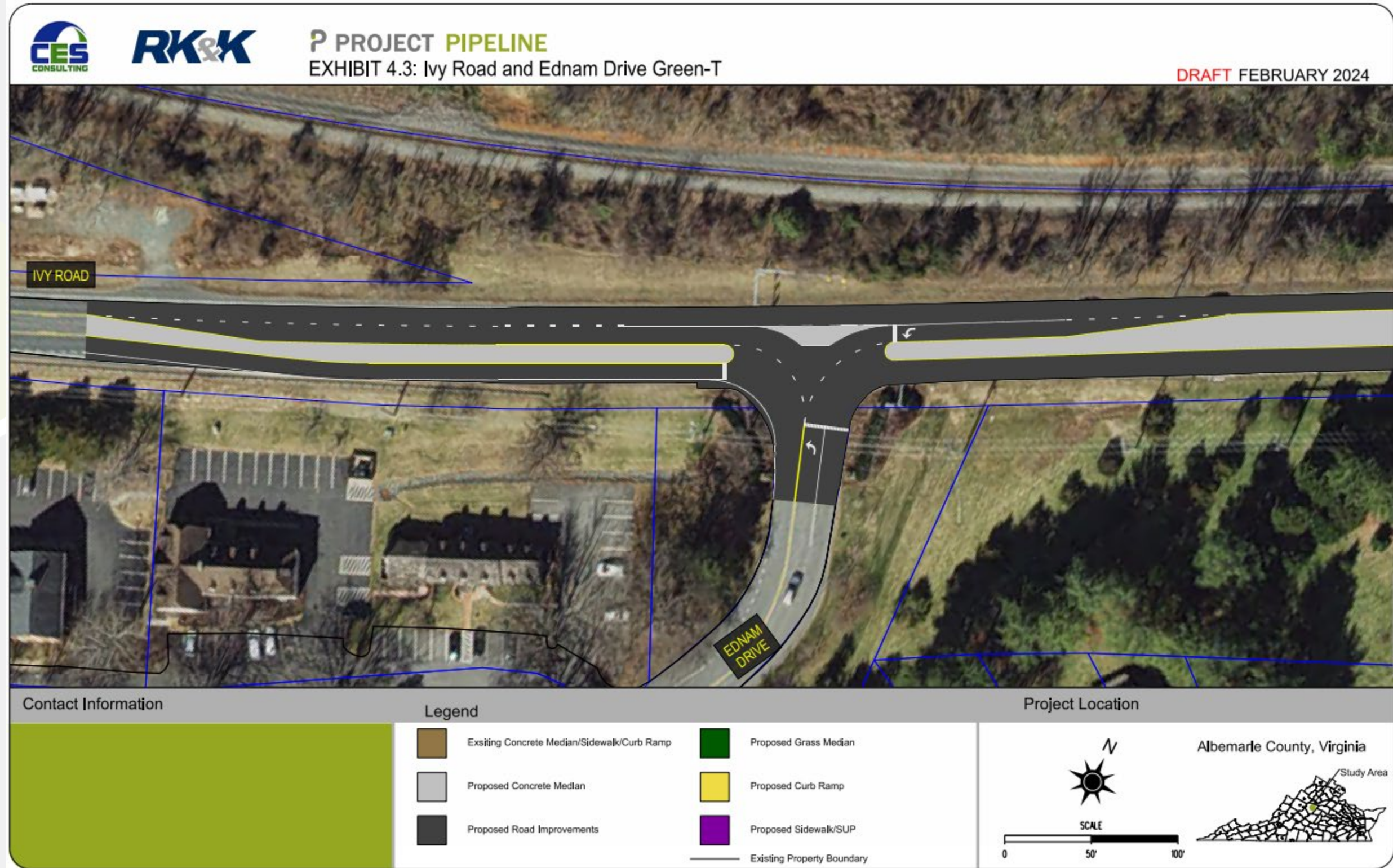


Figure 2-3 Ivy Road – Layout for Farmington Road - Roundabout

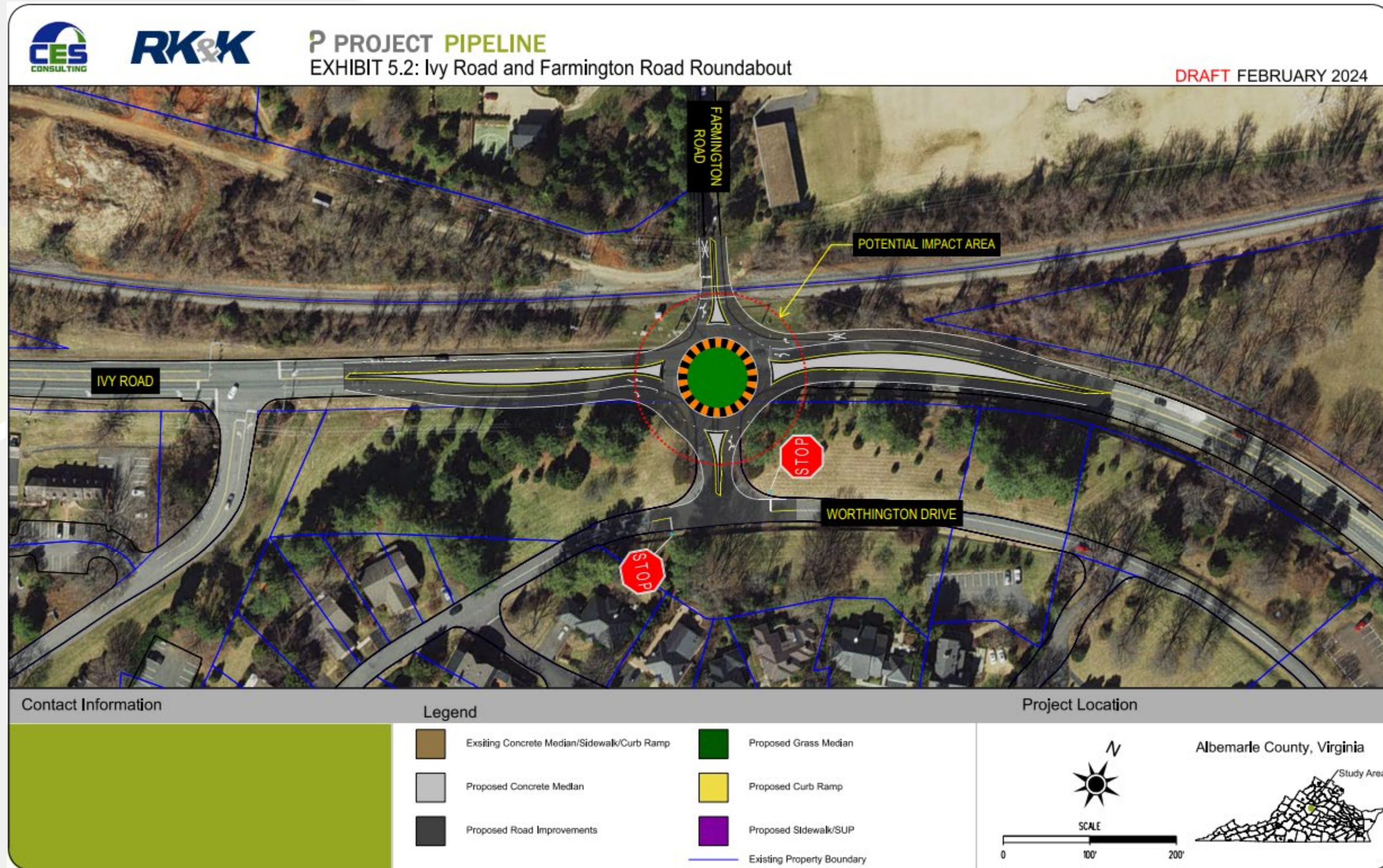


Figure 2-4 Ivy Road – Layout for the Western Package – Raised Median

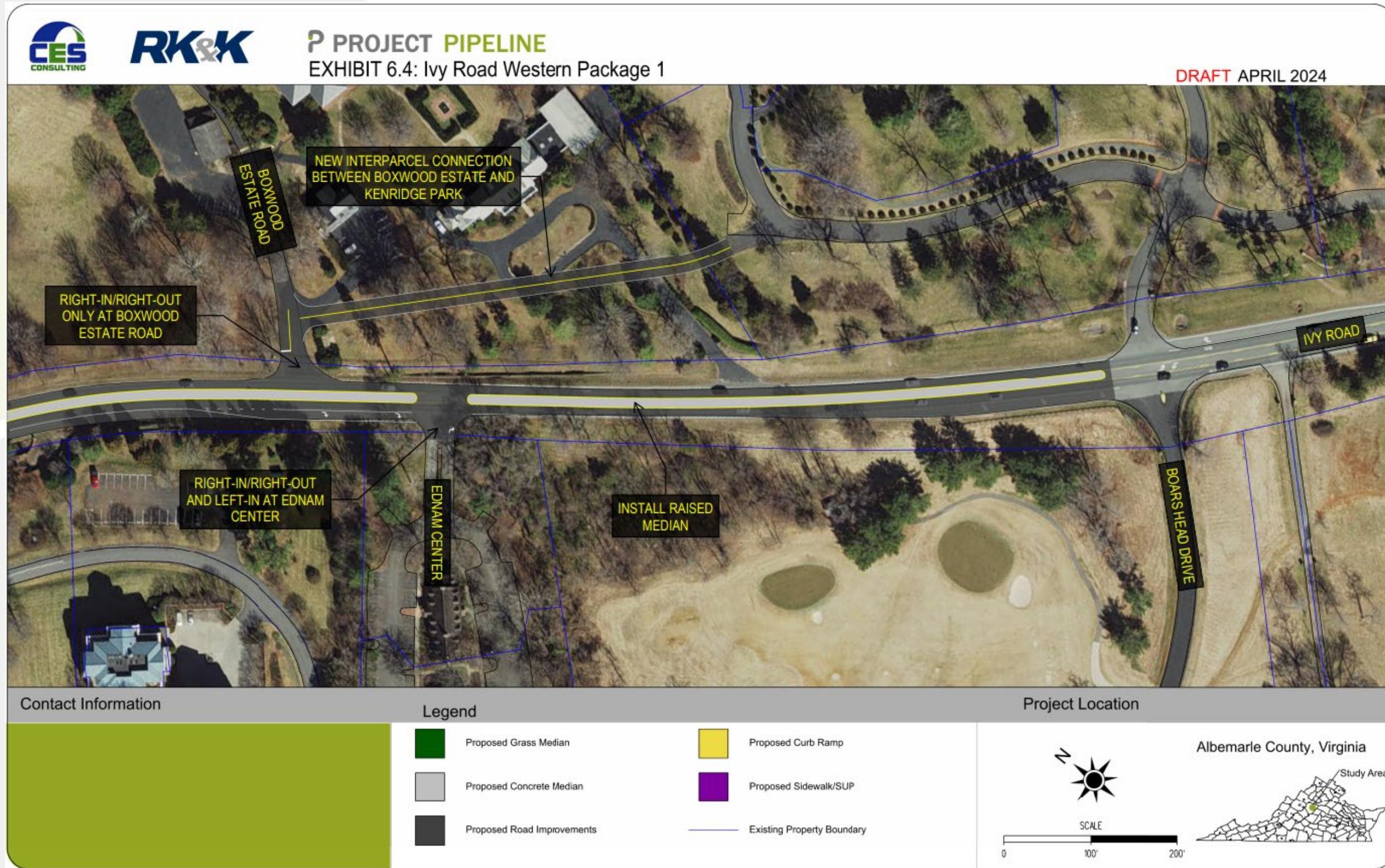


Figure 2-5 Ivy Road – Layout for Boars Head Drive - Roundabout

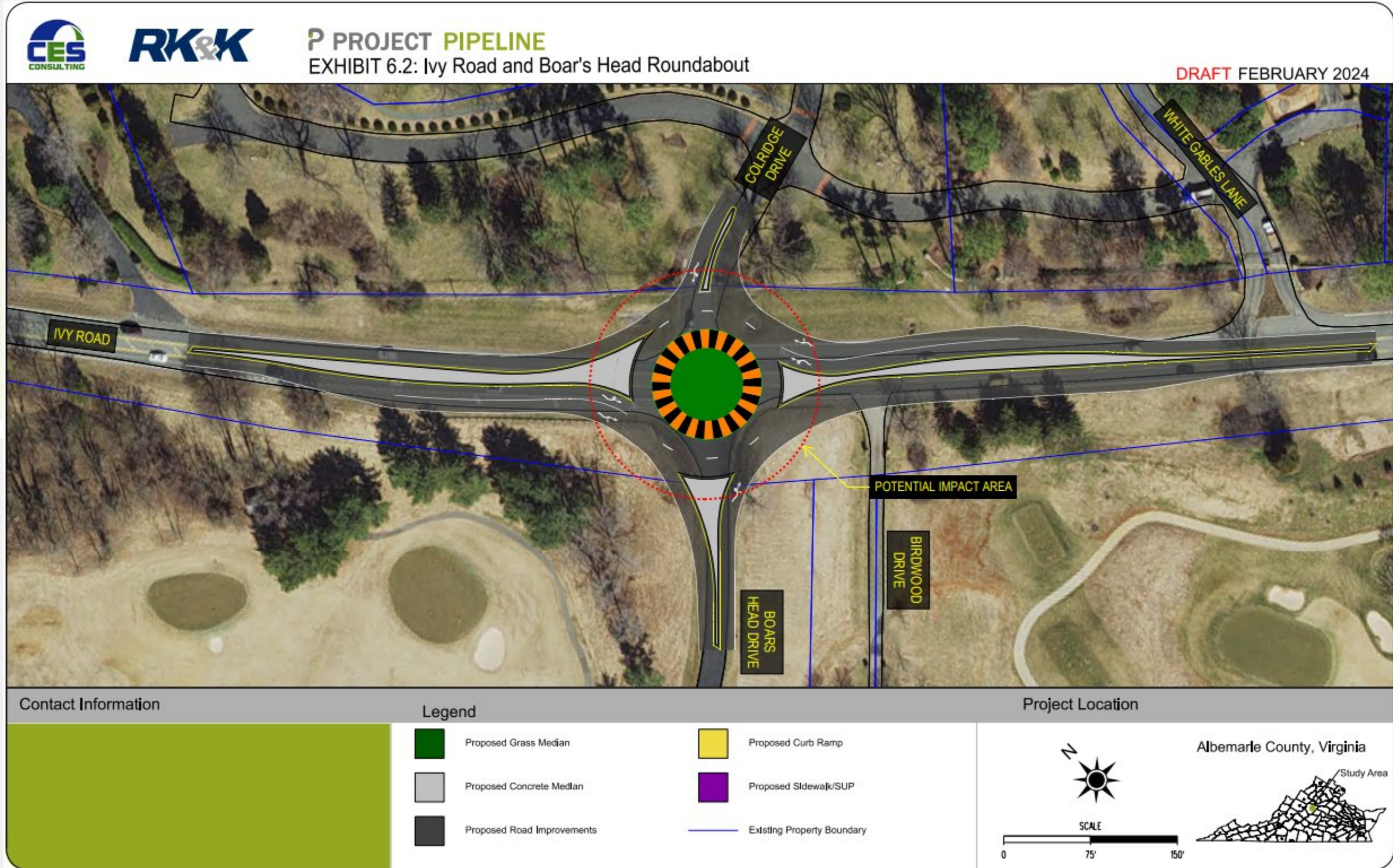


Figure 2-6 Ivy Road – Layout for Old Garth Road - Roundabout

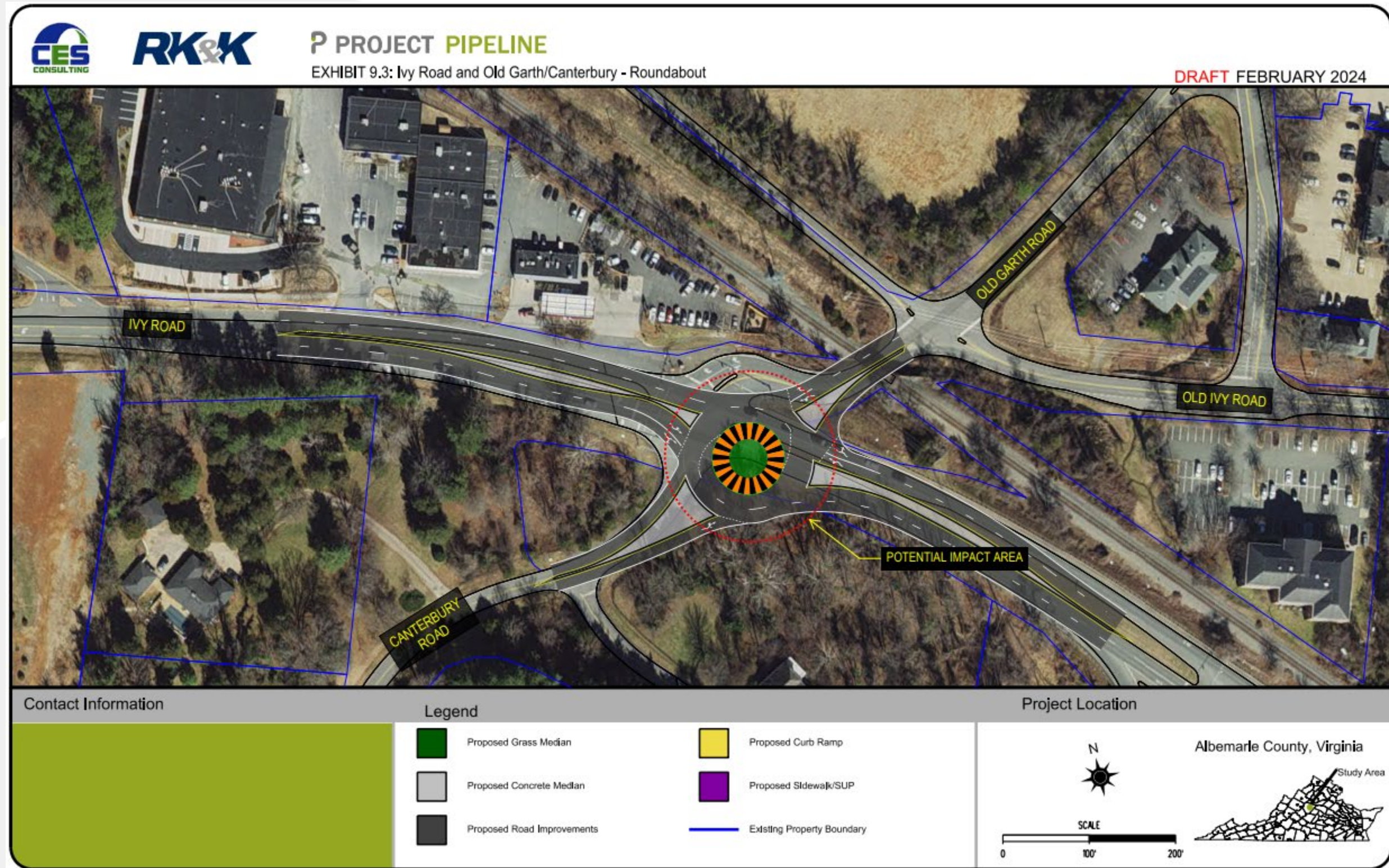


Figure 2-7 Ivy Road – Layout for Old Garth Road – Dual Right Turn



Figure 2-8 Ivy Road – Layout for Old Garth Road – Triangle-about

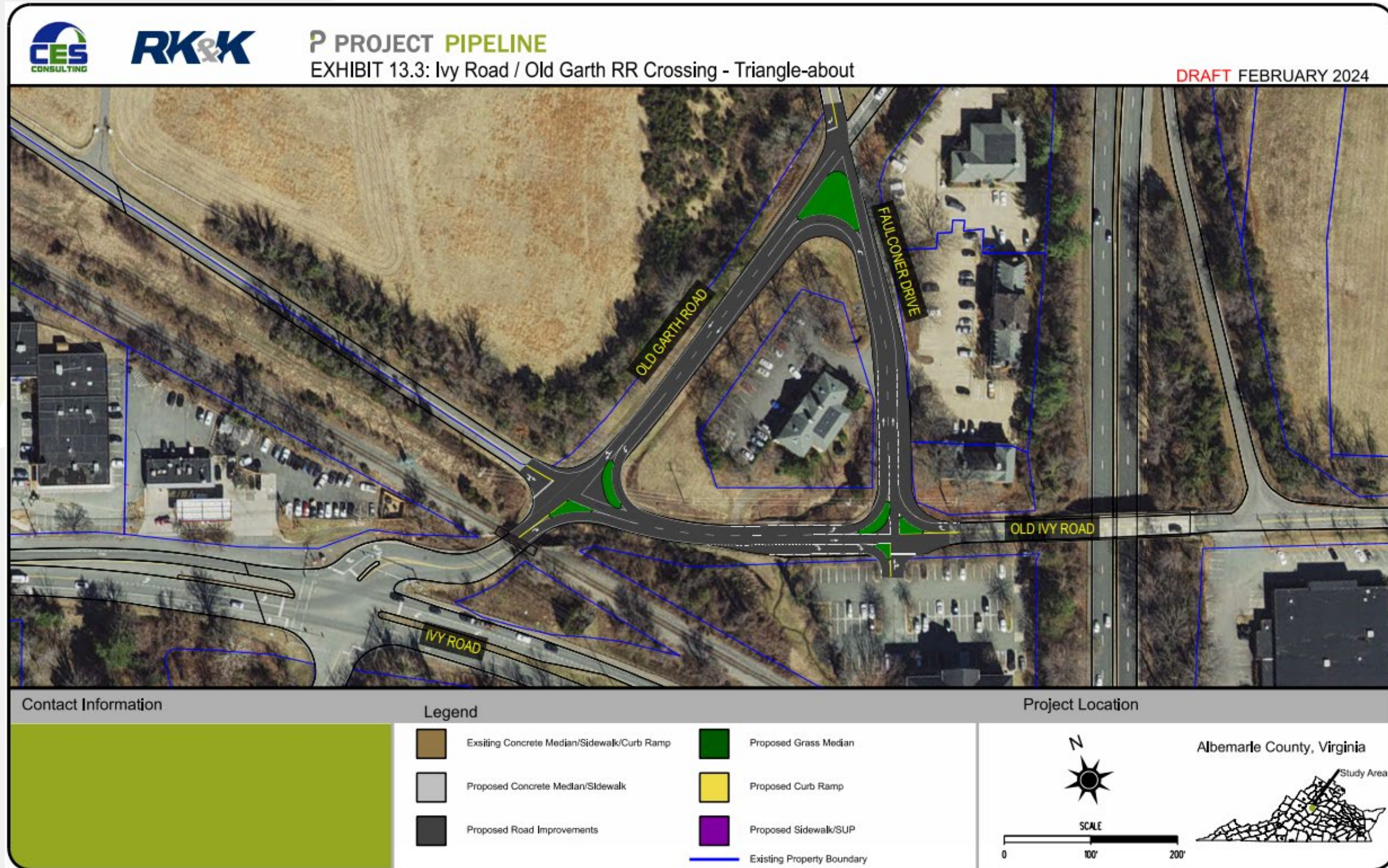


Figure 2-9 Ivy Road – Layout for US 29 Interchange – Ramp Extensions

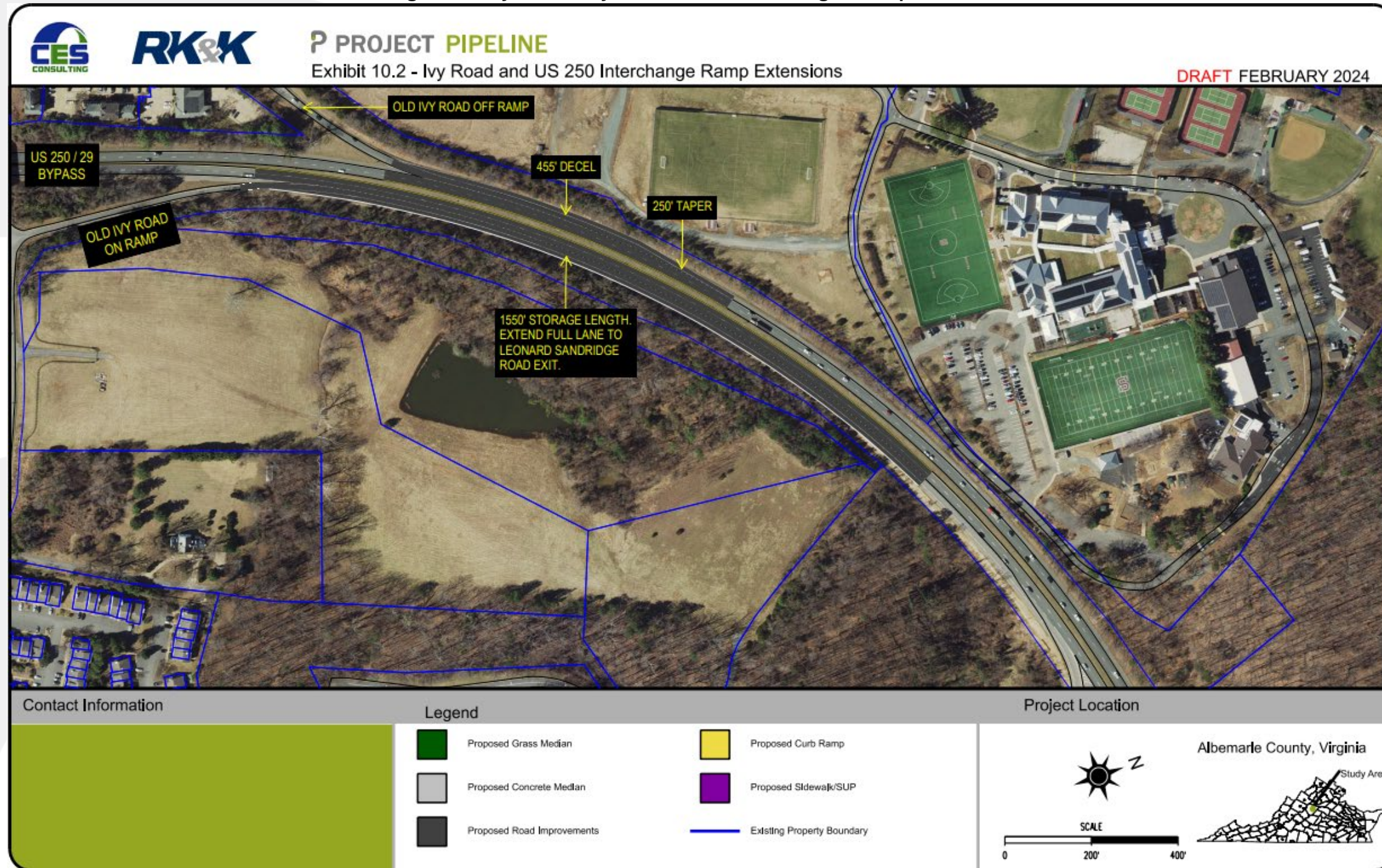


Figure 2-10 Ivy Road – Layout for US 29 Interchange – Bridges Replacement

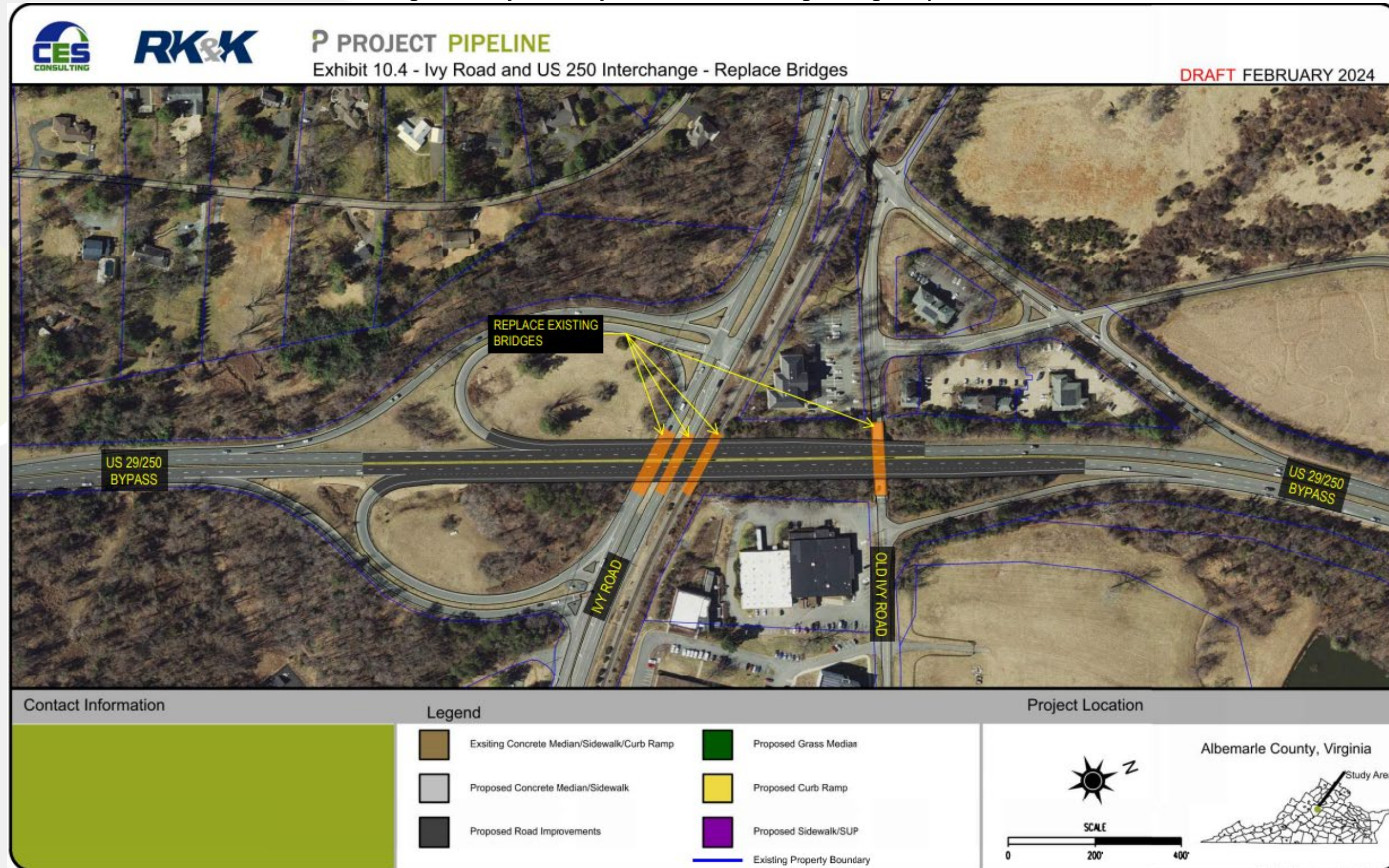


Figure 2-11 Ivy Road – Layout for US 29 Interchange – Elongated Ramps

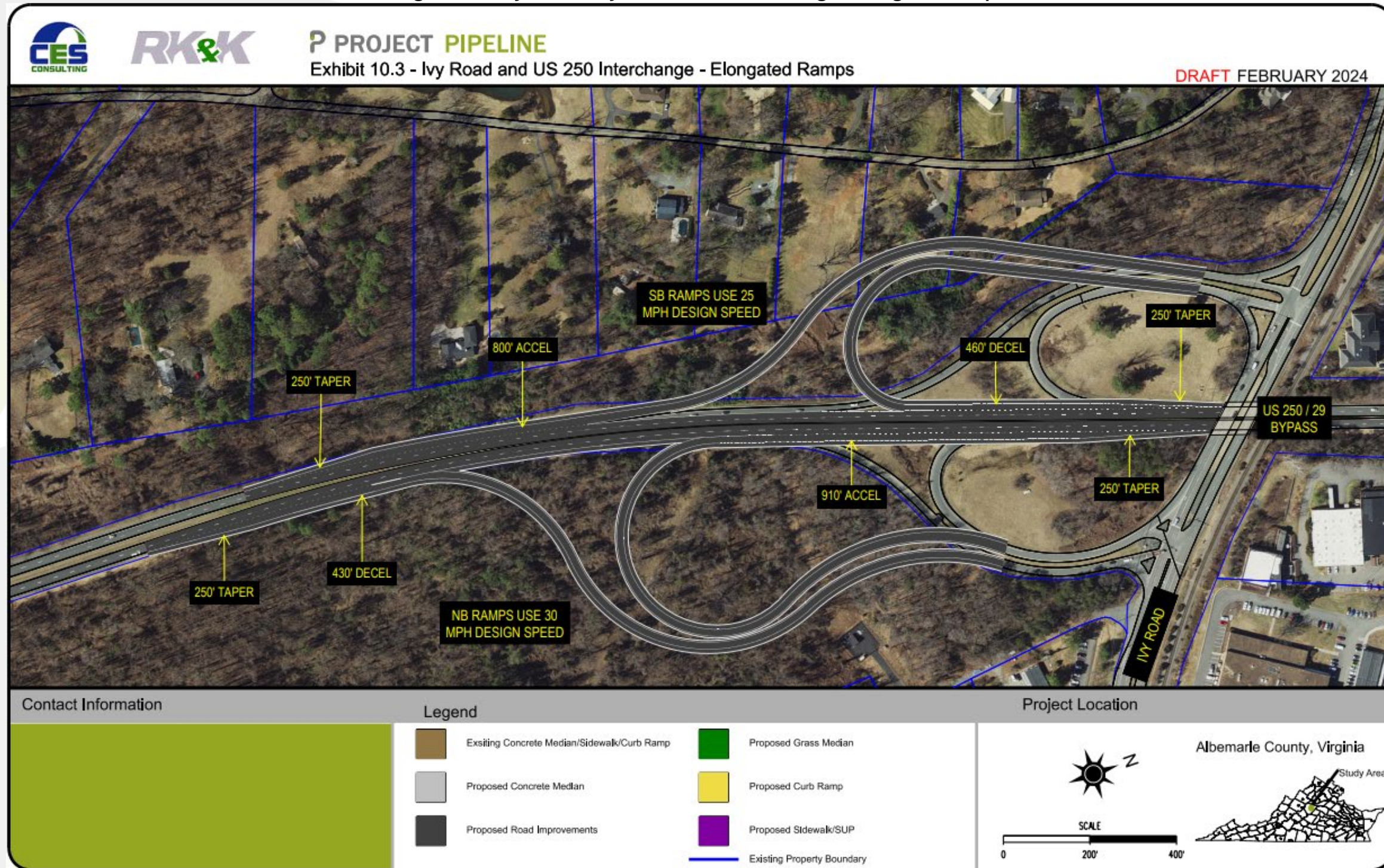
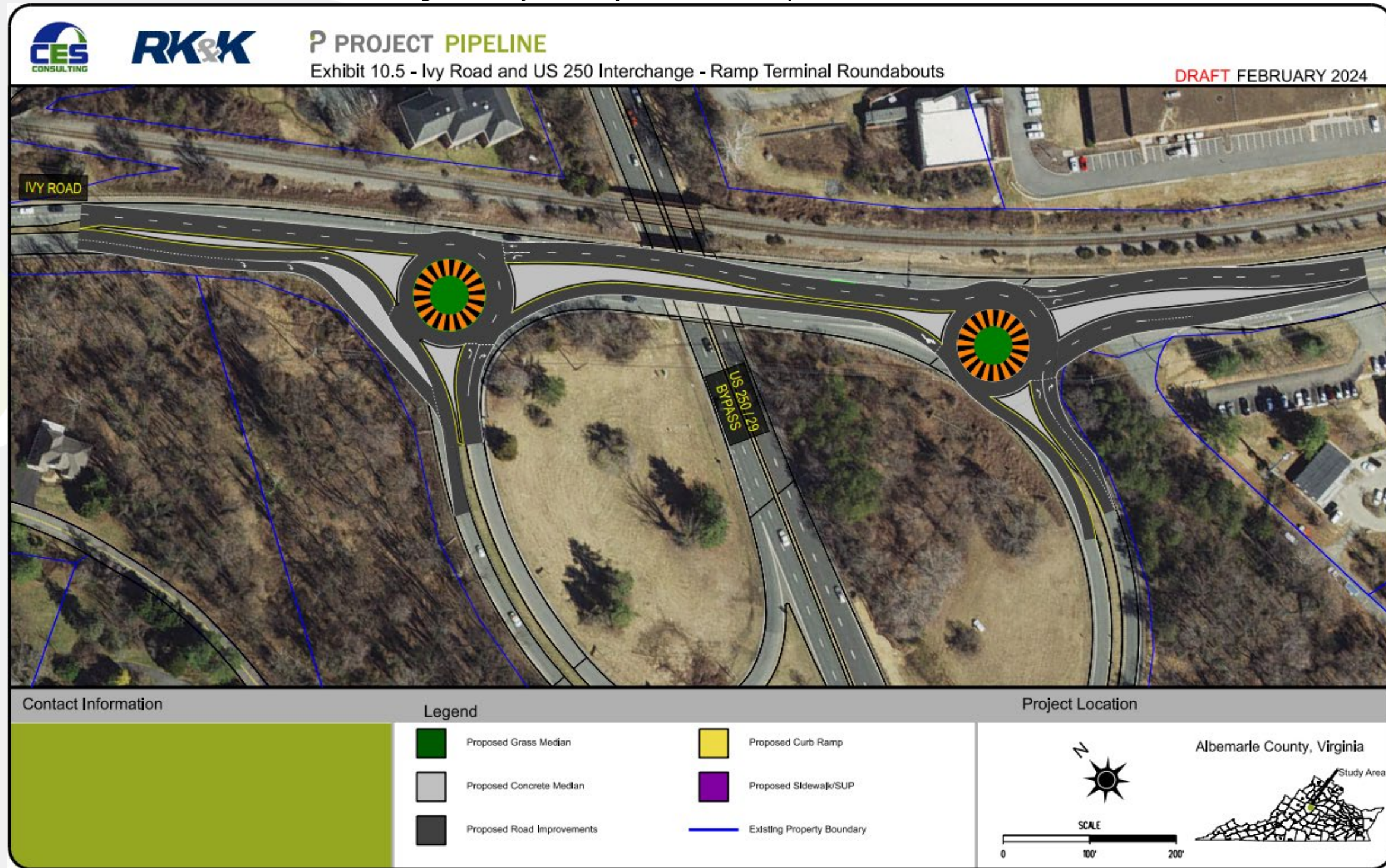


Figure 2-12 Ivy Road – Layout for US 250 Ramp Terminal Roundabouts





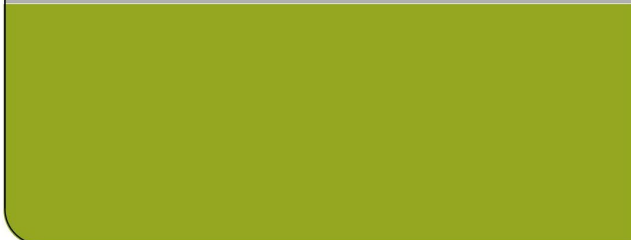
PROJECT PIPELINE

EXHIBIT 12.3: Ivy Road / Old Ivy Intersection - Advance Stop Bar

DRAFT APRIL 2024



Contact Information



Legend

- Proposed Road Improvements
- Proposed Sidewalk/SUP

Project Location

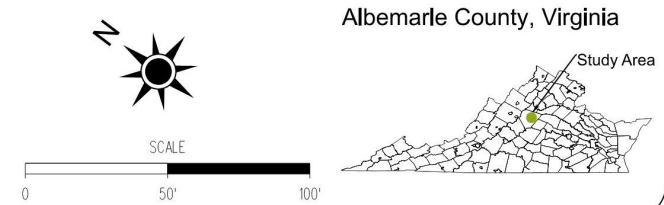


Figure 2-13 Ivy Road – Layout for Old Ivy Road – Advance Stop Bar

Figure 2-14 Ivy Road – Layout for One way Westbound

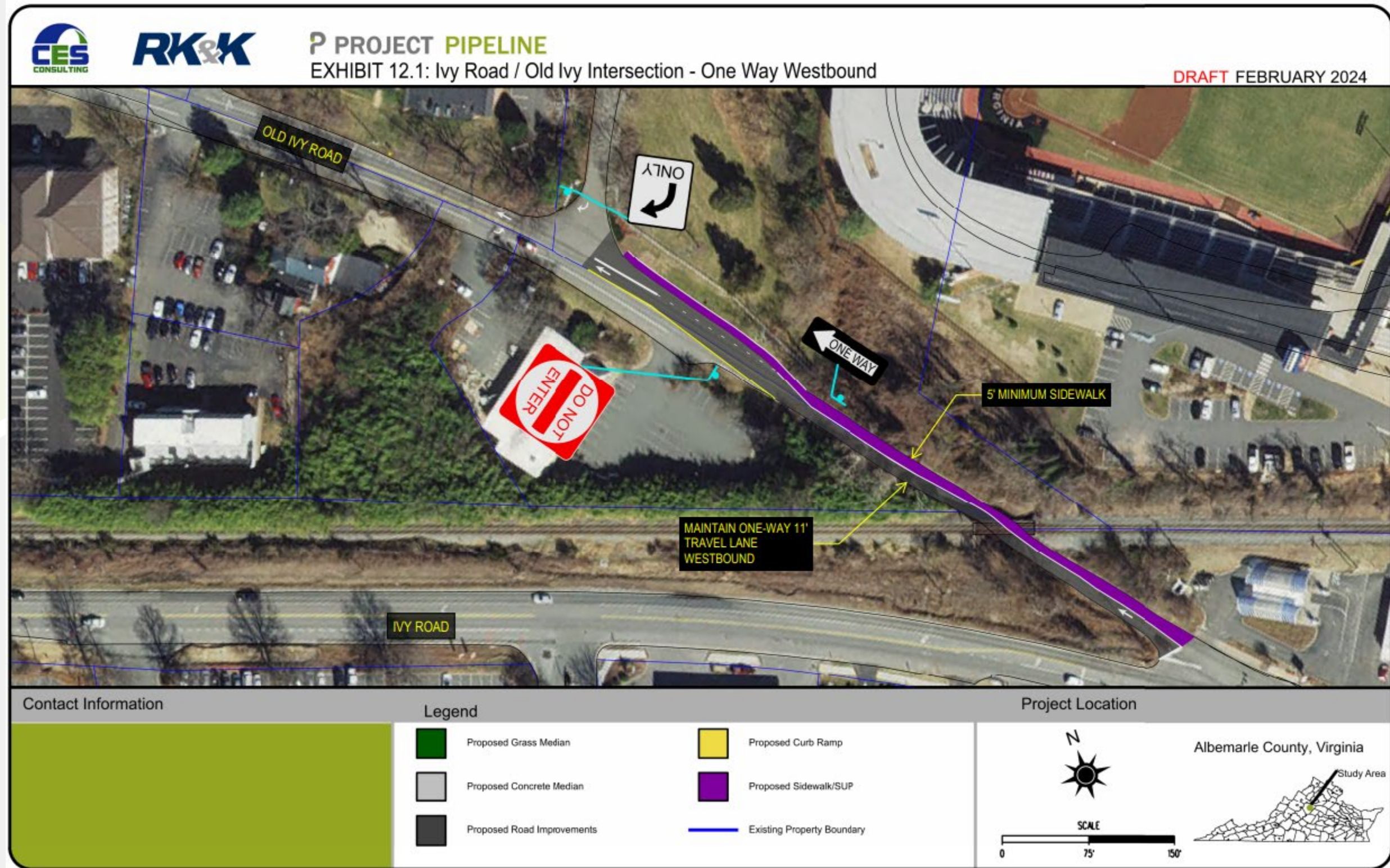


Figure 2-15 Ivy Road – Layout for Old Ivy Road – Shared Use Path (1 of 3)

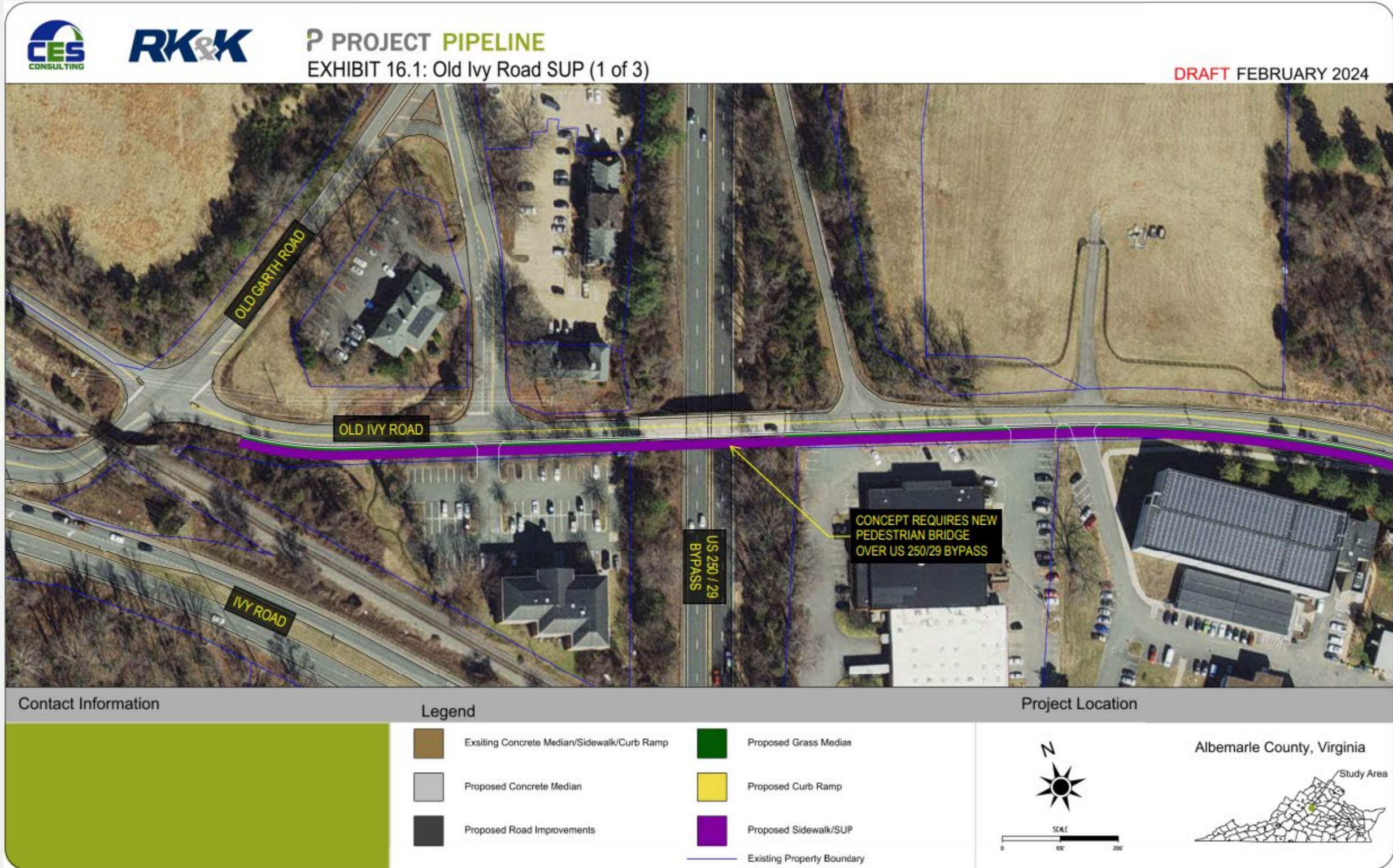


Figure 2-16 Ivy Road – Layout for Old Ivy Road – Shared Use Path (2 of 3)

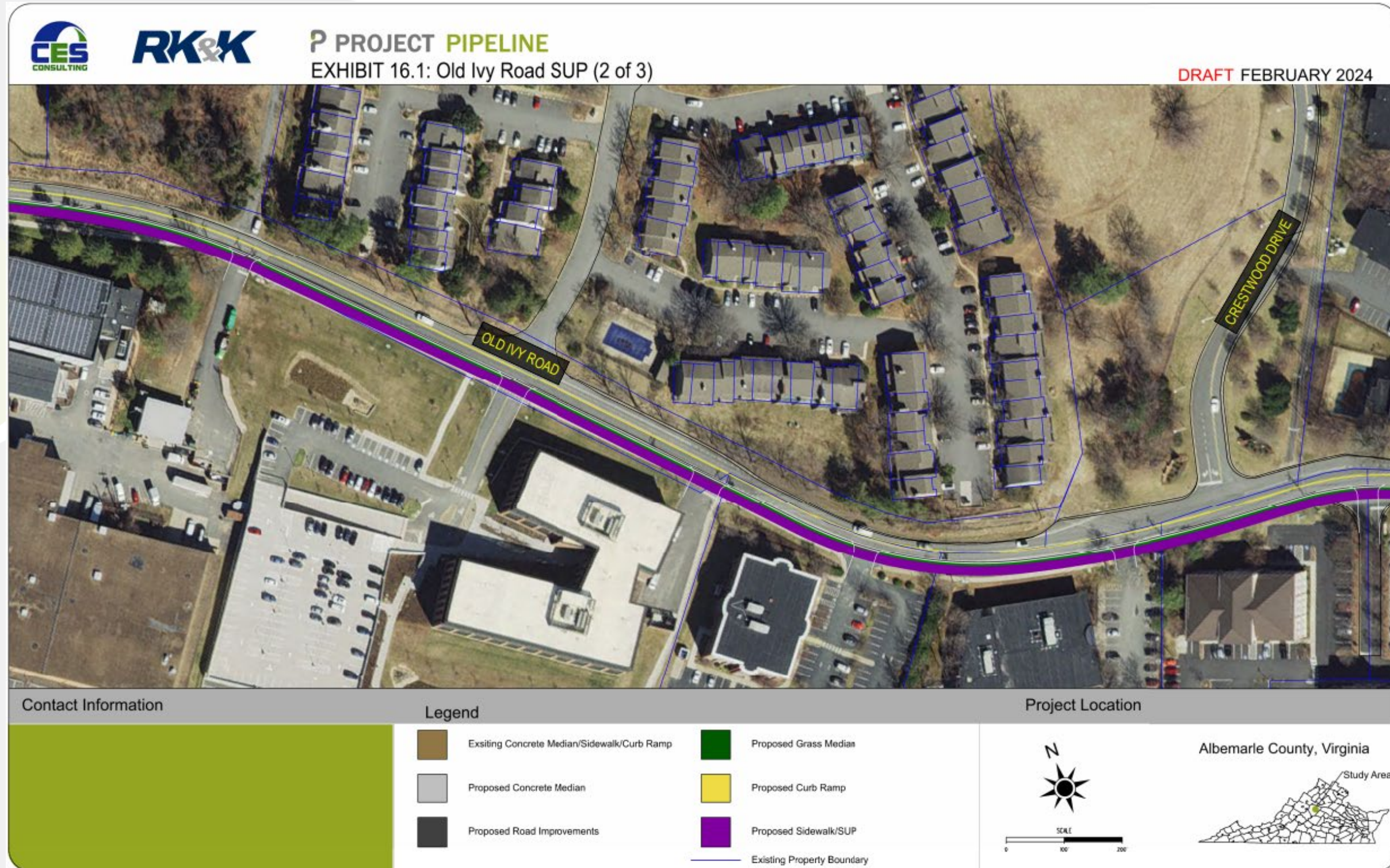


Figure 2-17 Ivy Road – Layout for Old Ivy Road – Shared Use Path (3 of 3)

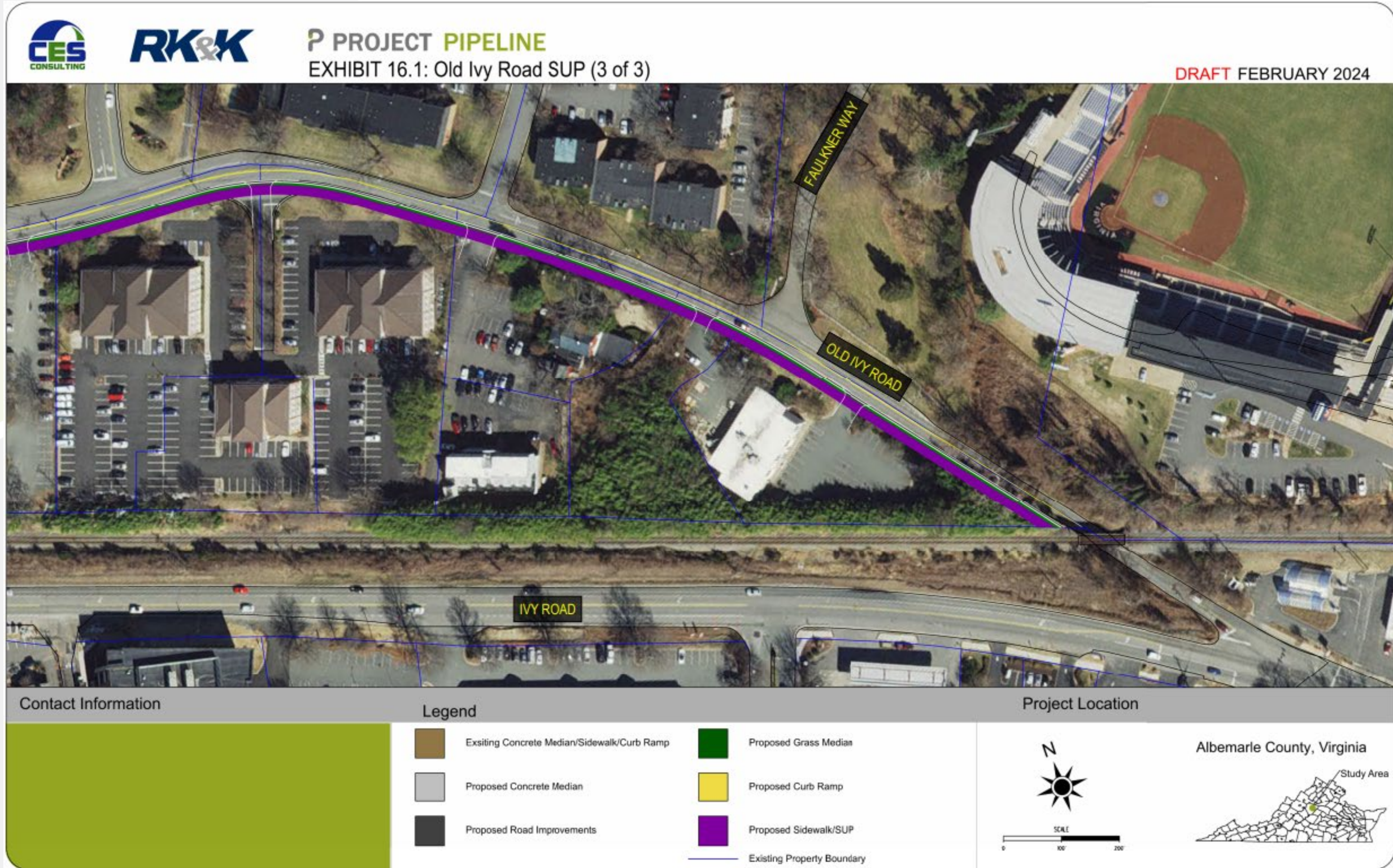
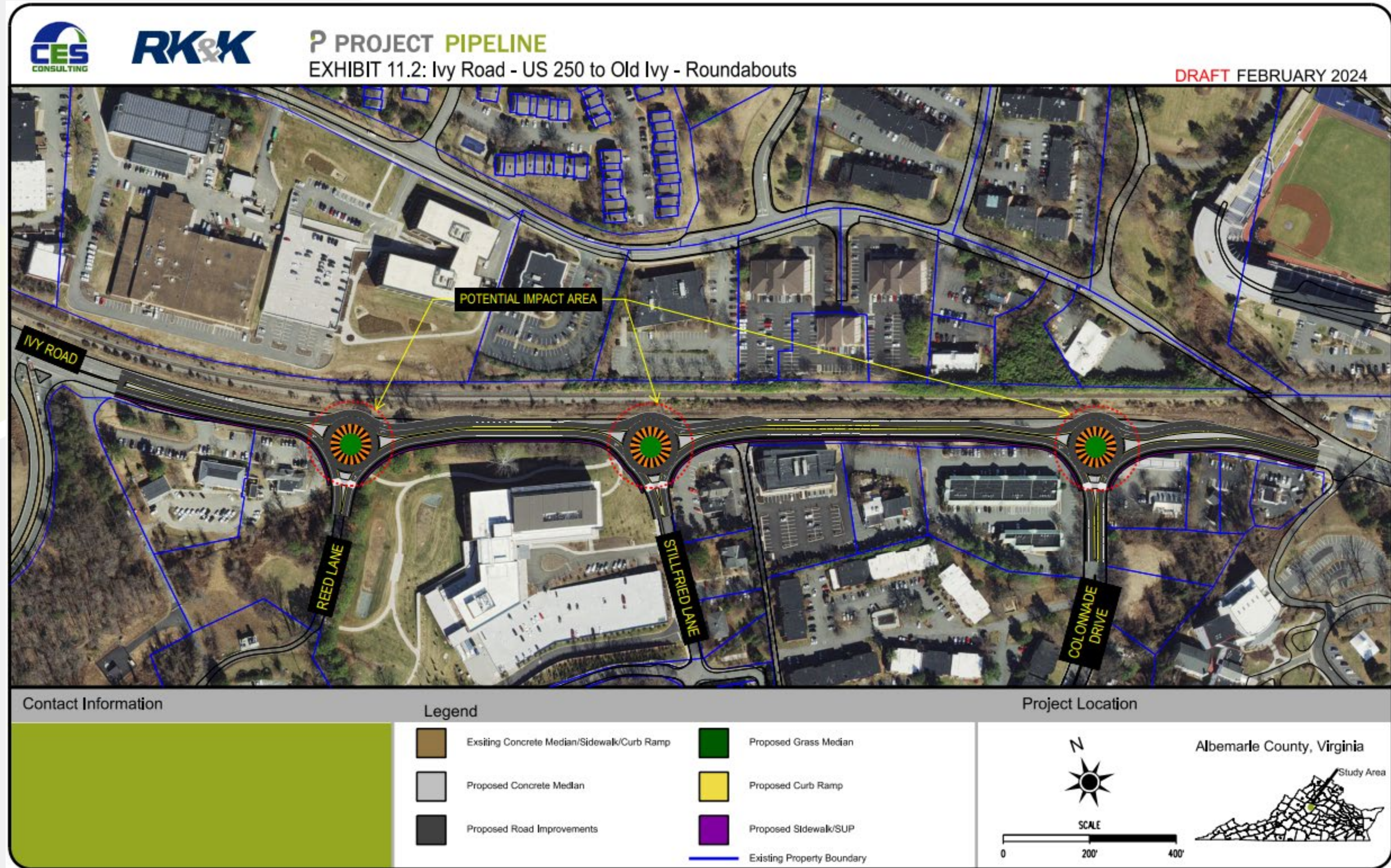


Figure 2-18 Ivy Road – Layout for Roundabouts From US 250 to Old Ivy Road



Anticipated Safety Performance

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

- Ednam Drive (Signalized) – Convert to a right-in/right-out and Green-T intersection.
- Farmington Drive (Signalized) – Convert to a roundabout and right-in/right-out intersection.
- Boxwood Estate Road (Stop Controlled) – Raised median between Boxwood Estate to Boars Head Drive, and the intersection is converted to right-in/right-out.
- Colridge Drive/Boar's Head Drive (Stop Controlled) – convert the intersection to a hybrid roundabout.
- Canterbury Road/Old Garth Road (Signalized) – convert the intersection to a hybrid roundabout, add dual right southbound turn lanes, and a triangle-about.
- US 29 Southbound Ramps (Signalized) – Convert the intersection to a hybrid roundabout and extend acceleration/deceleration lanes.
- US 29 Northbound Ramps (Signalized) – Convert the intersection to a hybrid roundabout and extend acceleration/deceleration lanes.
- Reed Lane (Stop Controlled) – Convert the intersection to a hybrid roundabout.
- Stillfried Lane (Stop Controlled) – Convert the intersection to a hybrid roundabout.
- Colonnade Drive (Stop Controlled) – Convert the intersection to a hybrid roundabout.
- Old Ivy Road/St Annes Drive (Signalized) – Relocate stop bar (make timing changes), one-way traffic, shared use path, and channelized right turn.
- US 29 Bypass – Add lanes to the mainline (6 lanes total).

Table 2-49 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 reduce crashes significantly. Implementing roundabouts and alternative intersection designs reduces conflict points and improves traffic flow, resulting in safer conditions.

Table 2-49. Ivy Road – CMF Matrix for Build Concepts
TABLE 2-49. IVY ROAD – CMF MATRIX FOR BUILD CONCEPTS

Intersections	Build Concepts	CMF Matrix														SS Plann.CMF
		CMF ID/CMF Value														
		4679	4680	206	2219	4102	225/226	5215/5216	9821	227/228	11154	5215/5216	5215/5216	8655	11246	
															0.90	
Ivy Road at Ednam Drive	Right-in/Right-out								✓							
	Green-T													✓		
Ivy Road at Farmington Drive	Roundabout						✓									
	Right-in/Right-out								✓							
Ivy Road at Boxwood Estate Road	Right-in/Right-out								✓							
	Raised Median				✓											
Ivy Road at Boars Head Drive	Roundabout			✓												
Boars Head Drive to Old Garth Road	Raised Median				✓											
Ivy Road at Old Garth Road	Roundabout						✓									
	Dual SB Right Turns*															
	Triangle-about*															
Ivy Road at US 29 SB on/off-ramps	Roundabout						✓									
	Acceleration Lane												✓			
	Deceleration Lane	✓														
Ivy Road at NB US 29 on/off-ramps	Roundabout						✓									
	Acceleration Lane											✓				
	Deceleration Lane		✓													
Ivy Road at Reed Lane	Roundabout									✓						
Ivy Road at Stillfried Lane	Roundabout									✓						
Ivy Road at Colonnade Drive	Roundabout									✓						
Ivy Road at Old Ivy Road	Relocated Stop bar*															
	One-way Traffic*															
	Shared Use Path					✓									✓	
Old Ivy Road at NB US 29 On-Ramp	Channelized Right Turn										✓					
US 29 SB/NB Bypass N of Old Garth Road	Add lanes (6) Freeway															✓
US 29 NB Bypass Old Garth Road	Acceleration Lane							✓								
	Deceleration Lane		✓													

*No CMF available.

Recommended Improvement Timing

The study team made recommendations for the timing of the improvements based on the immediacy of the need (safety or capacity), the cost of the improvement, and its ability to be funded.

Short-Term Improvements – Improvements that should be pursued over the next five to ten years because of an immediate need for safety or capacity improvement.

- Boars Head Drive – Proposed Hybrid Roundabout [Figure 2-5]
- Canterbury Road/Old Garth Road – Proposed Hybrid Roundabout [Figure 2-6]
- From Boars Head Drive to Canterbury Road/Old Garth Road - raised median (non-traversable) [Figure 2-5, Figure 2-6]
- NB Bypass – extend the acceleration lane from Old Ivy Road to Leonard Sandridge Road [Figure 2-9]
- SB Bypass – extend the deceleration lane to Old Ivy Road [Figure 2-9]
- Old Ivy Road “Triangle-about” [Figure 2-8]
- Old Ivy Road Shared Use Path [Figure 2-15, Figure 2-16, Figure 2-17]

- Old Ivy Rd. – two-way traffic under the RR underpass that is signalized with a sidewalk; removal of the EBL movement [



- Figure 2-13]

Long-Term Improvements – Improvements that may be pursued in ten-plus years to mitigate future safety or capacity deficiencies.

- Ednam Dr. – right-in/right-out & left-in only [Figure 2-1]
- Farmington Dr. – roundabout [Figure 2-3]
- From Farmington Drive to Boars Head Road – raised median (non-traversable) [Figure 2-4]
- Boxwood Estate Rd. – right-in/right-out only [Figure 2-4]
- Ednam Center – right-in/right-out & left-in only [Figure 2-4]
- Boxwood Driveway – None (raised median) [Figure 2-4]
- SB Bypass ramp terminal – roundabout [Figure 2-12]
- NB Bypass ramp terminal – roundabout [Figure 2-12]
- Ivy Road Bypass bridge replacement and widening (potentially a very long-term improvement – 20+ years) [Figure 2-10]
- Old Ivy Road bridge replacement and widening (potentially a very long-term improvement – 20+ years) [Figure 2-10]
- From west of Reed Lane to Colonnade Drive – raised median (non-traversable) [Figure 2-18]
- Reed Ln. – roundabout [Figure 2-18]
- Stillfried Ln. – roundabout [Figure 2-18]
- Colonnade Dr. – roundabout [Figure 2-18]
- NB Bypass – extend the Ivy Rd. on-ramp under the bridge (potentially a very long-term improvement – 20+ years; requires Ivy Road and Old Ivy Road bridge replacements) [Figure 2-10]
- SB Bypass – extend the Ivy Rd. off-ramp under the bridge (potentially a very long-term improvement – 20+ years; requires Ivy Road and Old Ivy Road bridge replacements) [Figure 2-10]
- Bypass – widening to 6 lanes (potentially a very long-term improvement – 20+ years; requires Ivy Road and Old Ivy Road bridge replacements)
- Railroad bridges over Old Garth Road and Old Ivy Road – replacement and widening (potentially a very long-term improvement – 20+ years; likely requires the double tracking of the railroad to bypass the bridge during replacement) [Figure 2-10]

Two long-term improvements are contingent on other improvements – the NB Bypass acceleration lane extension and the SB Bypass deceleration lane extension depend on the Ivy Road, Old Ivy Road, and the railroad bridges being widened at the Ivy Road interchange. These large-scale improvements would likely also be designed to accommodate the potential future widening of the Bypass to six lanes.

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 eleven locations along the Ivy 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. Ednam Drive (Signalized)
2. Farmington Drive (Signalized)
3. Boxwood Estate Road (Stop Controlled)
4. Colridge Drive/Boars Head Drive (Stop Controlled)
5. Canterbury Road/Old Garth Road (Signalized)
6. US 29 Southbound Ramps (Signalized)
7. US 29 Northbound Ramps (Signalized)
8. Reed Lane (Stop Controlled)
9. Stillfried Lane (Stop Controlled)
10. Colonnade Drive (Stop Controlled)
11. Old Ivy Road/St Annes Drive (Signalized)

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

Figure 3-1. Survey Result – Ivy Road Corridor Alternatives

Ivy Road Study Alternatives (CU-23-09)			
Project Engagement			
VIEWS	PARTICIPANTS	RESPONSES	COMMENTS
6,764	1,215	31,651	1,914

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

- **Figure 3-2** shows the survey results for the overall western corridor Package 1. A total of 1,090 people scored the alternatives, and 516 provided written comments.
- AI Beta Analysis of Written Comments – Top 5 Themes
 - Concerns about Roundabouts
 - Support for Roundabouts
 - Lack of Bike/Pedestrian Infrastructure
 - Traffic Congestion Concerns
 - Safety Concerns for Elderly Drivers
- **Figure 3-3** shows the survey intersections alternatives for the overall western corridor Package 1.

Figure 3-2. Survey Result – Ivy Road – Western Corridor Package 1

Western Corridor Package 1					
Modification of the Ednam Drive intersection to provide only right-in/right-out and left-in access	22% 1. Strongly oppose	8% 2. Somewhat oppose	27% 3. Neutral	17% 4. Somewhat support	27% 5. Strongly support
Scored 3.19					
Installation of a roundabout at Farmington Drive	22% 1. Strongly oppose	7% 2. Somewhat oppose	12% 3. Neutral	18% 4. Somewhat support	41% 5. Strongly support
Scored 3.48					
Modification of the Boxwood Estate Road intersection to provide only right-in/right-out access	13% 1. Strongly oppose	6% 2. Somewhat oppose	35% 3. Neutral	17% 4. Somewhat support	29% 5. Strongly support
Scored 3.43					
Installation of a new interparcel connection between Boxwood Estate Road and Kenridge Park Road	10% 1. Strongly oppose	5% 2. Somewhat oppose	42% 3. Neutral	15% 4. Somewhat support	28% 5. Strongly support
Scored 3.46					
Modification of the Ednam Center intersection to provide only right-in/right-out and left-in access	14% 1. Strongly oppose	7% 2. Somewhat oppose	32% 3. Neutral	19% 4. Somewhat support	28% 5. Strongly support
Scored 3.38					
Installation of a raised median (to prevent turns across the median) between Boxwood Estate Road and Boars Head Drive as shown in the figure	15% 1. Strongly oppose	9% 2. Somewhat oppose	24% 3. Neutral	20% 4. Somewhat support	32% 5. Strongly support
Scored 3.46					
Installation of a roundabout at Boars Head Drive/Colridge Drive (assumed improvement associated with the Middle Corridor Improvement Packages)	18% 1. Strongly oppose	7% 2. Somewhat oppose	13% 3. Neutral	17% 4. Somewhat support	44% 5. Strongly support
Scored 3.61					
1,090 respondents					

Figure 3-3. Survey Intersections – Ivy Road – Western Corridor Package 1



Table 3-1. Survey Result – Ivy Road – Western Corridor Package 1

Top Five Mentions		Top Five Positive Comments			Top Five Negative Comments		
Keyword	Total Mentions	Keyword	Keyword	Total Mentions	Keyword	Keyword	Total Mentions
Traffic	151	Roundabouts	34	108	Traffic	44	151
Roundabout	95	Shared Use Path	30	44	Roundabouts	32	108
US 250	83	Package	25	30	Farmington	16	67
Farmington	67	Traffic	23	151	Area - Corridor	14	53
Area - Corridor	53	Transportation Corridor	23	26	Ednam	14	45

- **Table 3-1** shows the written survey results for western corridor Package 1 at the intersections on Ivy Road. It summarizes the top five keyword mentions and how many times the word was mentioned as positive or negative outcomes. 516 written comments were provided on this package.

- **Figure 3-4** shows the survey results for the overall western corridor Package 2. 825 people scored the alternatives, and 286 provided written comments.
- AI Beta Analysis of Written Comments – Top 5 Themes
 - Concerns about Bike/Pedestrian Safety
 - Support for Shared Use Path
 - Opposition to Raised Medians
 - Concerns about Traffic Congestion
 - Opposition to Green-T Intersections
- **Figure 3-5** displays the survey intersections alternatives for the overall western corridor Package 2.

Figure 3-4. Survey Result – Ivy Road – Western Corridor Package 2

Western Corridor Package 2					
Modification of the Ednam Drive Intersection to provide a Green-T Intersection Scored 3.14	18% 1. Strongly oppose	11% 2. Somewhat oppose	29% 3. Neutral	23% 4. Somewhat support	19% 5. Strongly support
Modification of the Ednam Center intersection to provide only right-in/right-out and left-in access Scored 3.33	15% 1. Strongly oppose	7% 2. Somewhat oppose	34% 3. Neutral	20% 4. Somewhat support	25% 5. Strongly support
Installation of a raised median (to prevent turns across the median) between Ednam Center and Boars Head Drive/Colridge Drive Scored 3.43	13% 1. Strongly oppose	9% 2. Somewhat oppose	28% 3. Neutral	19% 4. Somewhat support	30% 5. Strongly support
Installation of a roundabout at Boars Head Drive/Colridge Drive (assumed improvement associated with the Middle Corridor Improvement Packages) Scored 3.70	17% 1. Strongly oppose	6% 2. Somewhat oppose	13% 3. Neutral	18% 4. Somewhat support	46% 5. Strongly support
825 respondents					

Figure 3-5. Survey Intersections – Ivy Road – Western Corridor Package 2



Table 3-2 shows the written survey results for western corridor Package 2 at the intersections on Ivy Road. It summarizes the top five keyword mentions and how many times the word was mentioned as positive or negative outcomes. 286 respondents provided written comments.

Table 3-2. Survey Result – Ivy Road – Western Corridor Package 2

Top Five Mentions		Top Five Positive Comments			Top Five Negative Comments		
Keyword	Total Mentions	Keyword	Keyword	Total Mentions	Keyword	Keyword	Total Mentions
Traffic	151	Package	32	43	Traffic	14	48
Roundabouts	108	Shared Use Path	22	33	Roundabouts	6	22
US 250	83	Three Notched Trail	19	23	People	5	12
Farmington	67	Transportation Corridor	19	19	Changes	5	11
Area - Corridor	53	Traffic	13	48	Raised Median	5	12

- **Figure 3-6** displays the survey results for the overall Focus Group Middle Corridor Package. 789 people scored the alternatives, and 334 provided written comments.
- AI Beta Analysis of Written Comments – Top 5 Themes
 - Supports for Shared Use Path
 - Concerns about Roundabouts
 - Pedestrian Safety Improvements
 - Opposition to One-Way Traffic
 - Supports Acceleration/Deceleration Lane Extensions
- **Figure 3-7** shows the survey intersections alternatives for the overall Focus Group Middle Corridor Package.

Figure 3-6. Survey Result – Ivy Road - Focus Group Middle Corridor Package



Figure 3-7. Survey Intersections – Ivy Road - Focus Group Middle Corridor Package



Table 3-3. Survey Result – Ivy Road - Focus Group Middle Corridor Package

Top Five Mentions		Top Five Positive Comments			Top Five Negative Comments		
Keyword	Total Mentions	Keyword	Keyword	Total Mentions	Keyword	Keyword	Total Mentions
Traffic	151	Corridor	30	35	Traffic	22	83
Roundabouts	108	Pedestrians	29	50	Road	16	43
US 250	95	Cyclists	28	42	People	10	23
Farmington	67	Route	25	28	Cars	9	30
Area - Corridor	53	Facility	24	25	Area	8	33

- **Figure 3-8** displays the survey results for the overall Other Short Term Middle Corridor Package. 699 people scored the alternatives, and 229 provided written comments.
- AI Beta Analysis of Written Comments – Themes
 - Supports Shared Use Path
 - Concerns about One-Way Traffic
 - Opposes Dual Right Turn Lanes
 - Supports Roundabouts
 - Concerns about Pedestrian Safety
- **Figure 3-9** shows the survey intersections alternatives for the overall Other Short Term Middle Corridor Package.

Table 3-3 shows the written survey results for the Focus Group Middle Corridor Package at the intersections on Ivy Road. It mentions how often the word was mentioned with positive or negative sentiment. 789 people scored the Focus Group Middle Corridor Package, and 334 provided written comments.

Figure 3-8. Survey Results – Ivy Road - Other Short Term Middle Corridor Package

Other Short Term Middle Corridor Package					
Installation of a roundabout at Boars Head Drive/Colridge Drive Scored 3.66	17% 1. Strongly oppose	6% 2. Somewhat oppose	16% 3. Neutral	16% 4. Somewhat support	45% 5. Strongly support
Installation of dual southbound right turn lanes at Old Garth Road/Canterbury Road Scored 3.07	25% 1. Strongly oppose	8% 2. Somewhat oppose	24% 3. Neutral	20% 4. Somewhat support	23% 5. Strongly support
Installation of a "Triangle-about" at the southbound Bypass off-ramp/Old Garth Road/Old Ivy Road area Scored 3.36	18% 1. Strongly oppose	7% 2. Somewhat oppose	24% 3. Neutral	23% 4. Somewhat support	28% 5. Strongly support
Installation of a channelized westbound right turn lane on Old Ivy Road at the northbound Bypass on-ramp Scored 3.69	11% 1. Strongly oppose	5% 2. Somewhat oppose	22% 3. Neutral	27% 4. Somewhat support	34% 5. Strongly support
Extension of the northbound and southbound Old Ivy Road Bypass ramps acceleration and deceleration lanes Scored 4.14	7% 1. Strongly oppose	2% 2. Somewhat oppose	15% 3. Neutral	20% 4. Somewhat support	56% 5. Strongly support
Installation of a 10' shared use path on the south side of Old Ivy Road Scored 4.03	9% 1. Strongly oppose	3% 2. Somewhat oppose	19% 3. Neutral	14% 4. Somewhat support	55% 5. Strongly support
Modification of the Old Ivy Road eastern railroad underpass to be westbound only with a raised 6' sidewalk on Old Ivy Road under the railroad underpass Scored 3.32	26% 1. Strongly oppose	7% 2. Somewhat oppose	16% 3. Neutral	13% 4. Somewhat support	38% 5. Strongly support
699 respondents					

Figure 3-9. Survey Intersections – Ivy Road - Other Short Term Middle Corridor Package

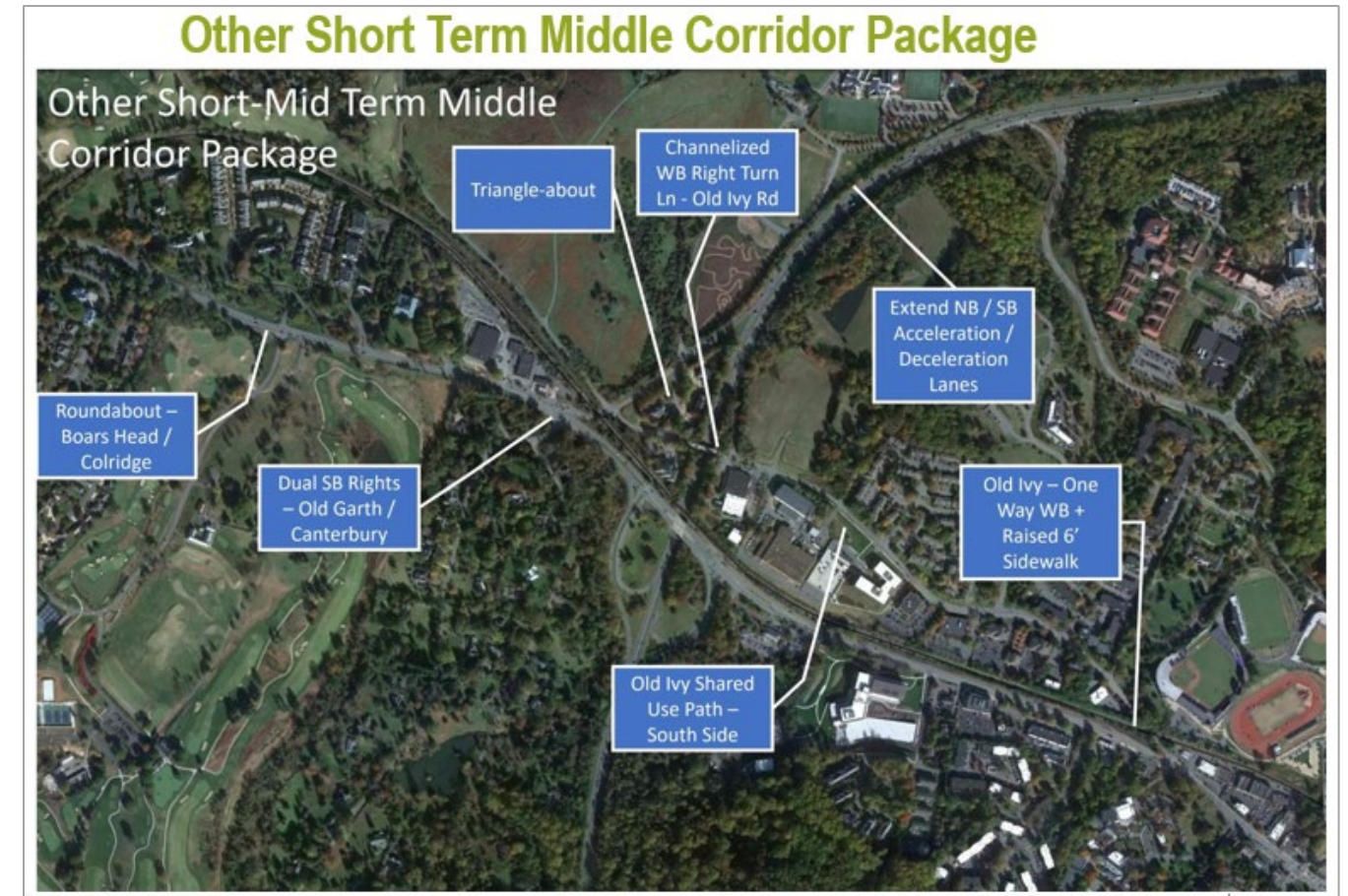


Table 3-4 shows the written survey results for the Other Short Term Middle Corridor Package at the intersections on Ivy Road. It cites how often the word was mentioned with positive or negative connotations. 699 people scored the Focus Group Middle Corridor Package, and 229 provided written comments.

Table 3-4. Survey Result – Ivy Road - Other Short Term Middle Corridor Package

Top Five Mentions		Top Five Positive Comments			Top Five Negative Comments		
Keyword	Total Mentions	Keyword	Keyword	Total Mentions	Keyword	Keyword	Total Mentions
Traffic	46	Pedestrians	25	33	Traffic	10	46
Use	36	Corridor	25	29	People	7	21
Pedestrians	33	Three Notched trail	23	25	Lanes	7	29
Old Ivy Road	29	Cyclists	22	26	Way	5	24
Package	29	Route	22	23	Roundabout	4	14

- **Figure 3-10** displays the survey results for the overall Long Term Middle Corridor Package. 667 people scored the alternatives, and 192 provided written comments.
- AI Beta Analysis of Written Comments – Themes
 - Concerns about Induced Demand
 - Support for Shared Use Path
 - Opposition to Road Widening
 - Support for Roundabouts
 - Need for Pedestrian and Cyclist Safety
- **Figure 3-11** shows the survey intersections alternatives for the overall Long Term Middle Corridor Package.

Figure 3-10. Survey Result – Ivy Road - Long Term Middle Corridor Package

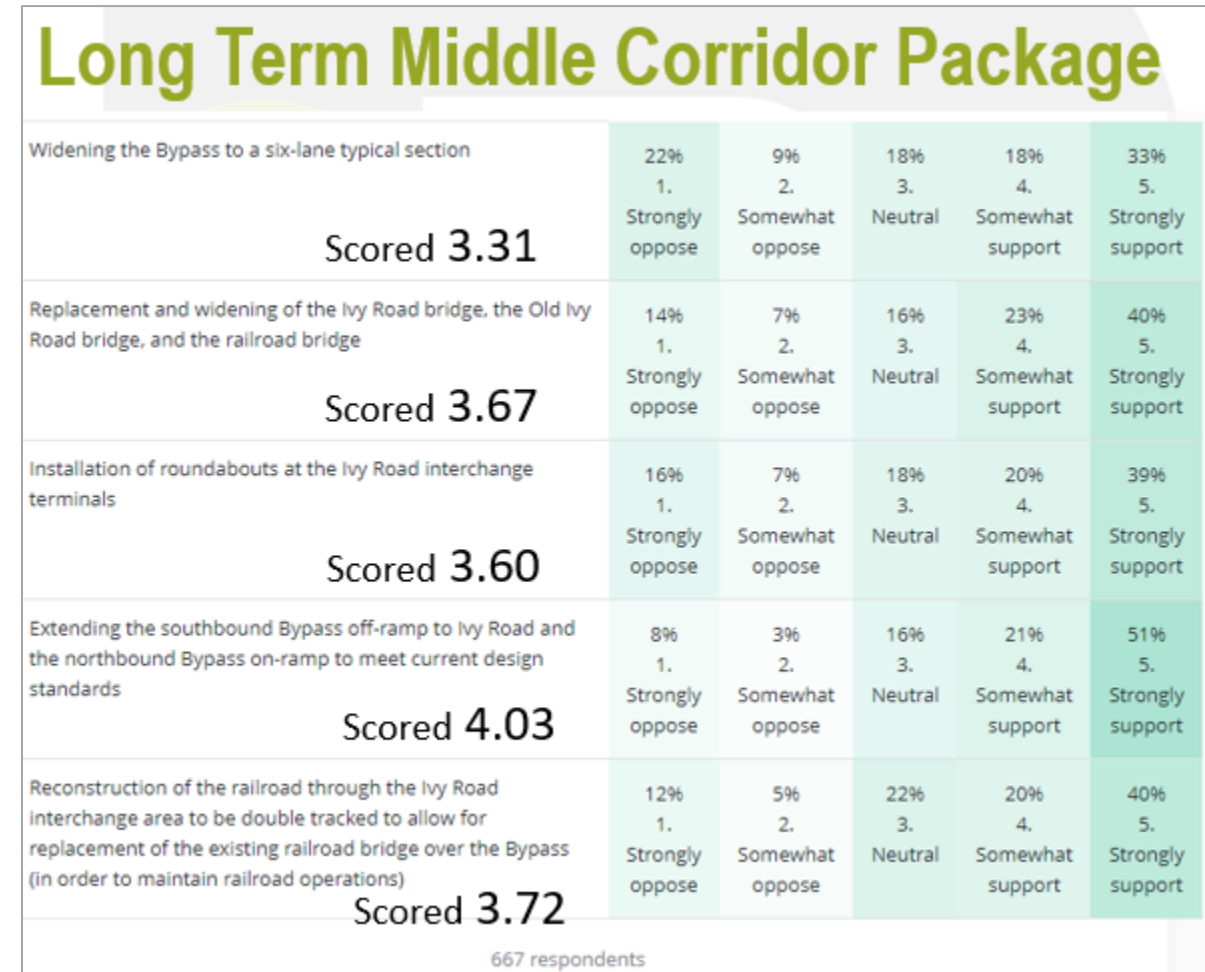


Figure 3-11. Survey Intersections – Ivy Road - Long Term Middle Corridor Package

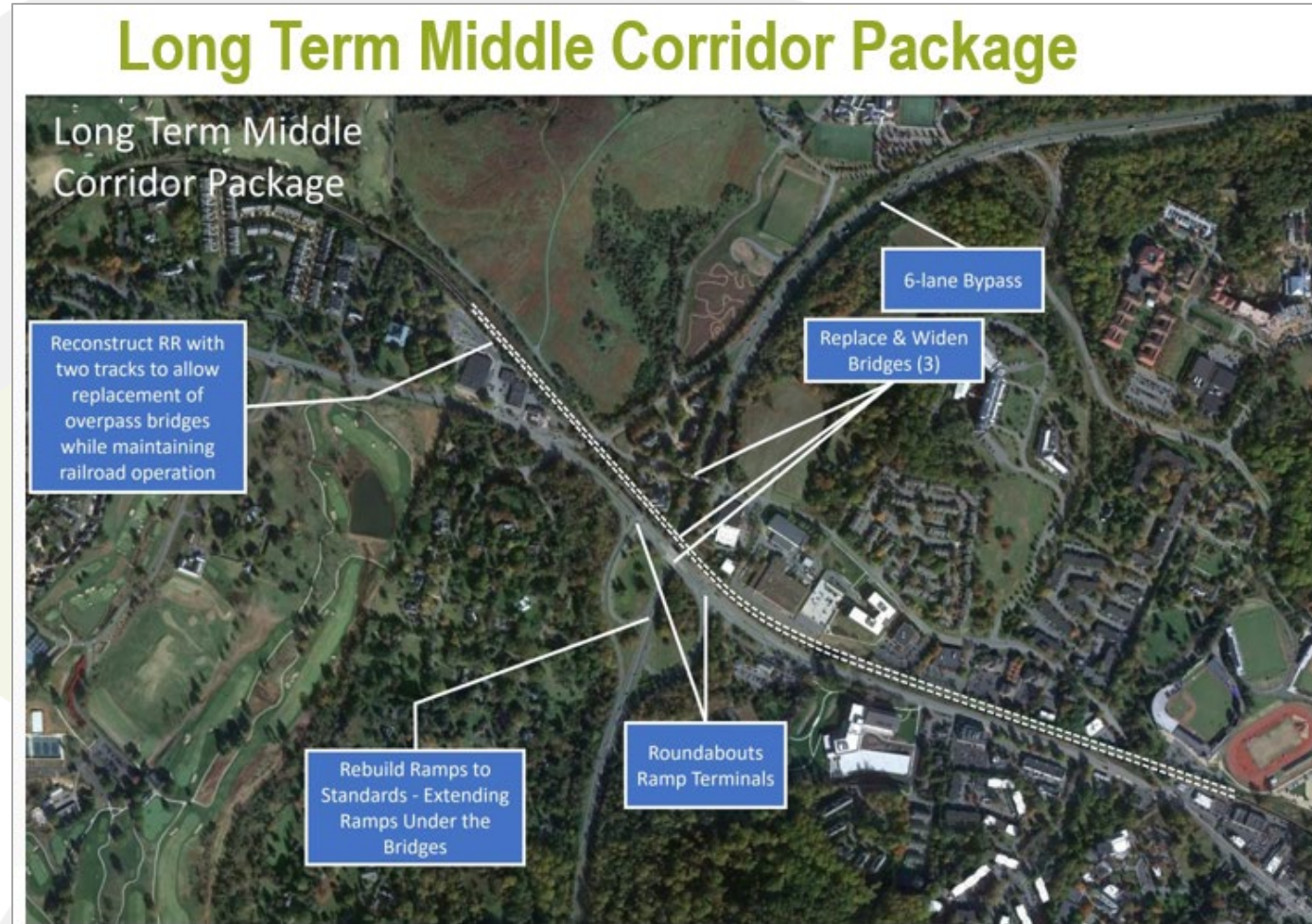


Table 3-5. Survey Result – Ivy Road - Long Term Middle Corridor Package

Top Five Mentions		Top Five Positive Comments			Top Five Negative Comments		
Keyword	Total Mentions	Keyword	Keyword	Total Mentions	Keyword	Keyword	Total Mentions
Lanes	29	Path	21	29	Traffic	8	25
Path	29	Use	19	24	Lanes	8	29
Traffic	25	Package	19	22	Bypass	7	24
Use	24	Transportation Corridor	17	17	Changes	5	11
Bypass	24	Three Notched Trail	14	16	Roundabouts	4	15

- **Figure 3-12** displays the survey results for the overall Eastern Corridor Package. 604 people scored the alternatives, and 181 provided written comments.
- AI Beta Analysis of Written Comments – Themes
 - Support for Roundabouts
 - Concerns about Roundabout Overuse
 - Support for Shared Use Path
 - Concerns about Traffic Congestion
 - Need for Pedestrian and Cyclist Safety
- **Figure 3-13** shows the survey intersections alternatives for the overall Eastern Corridor Package.

Table 3-5 shows the written survey results for the Long Term Middle Corridor Package at the intersections on Ivy Road. It displays how often the word was mentioned with positive or negative sentiment. 667 people scored the Focus Group Middle Corridor Package, and 192 provided written comments.

Figure 3-12. Survey Result – Ivy Road - Eastern Corridor Package

Eastern Corridor Package					
Installation of a raised median from the northbound Bypass ramp terminal to Colonnade Drive (to prevent left turns other than those at the proposed roundabouts) Scored 3.18	19% 1. Strongly oppose	8% 2. Somewhat oppose	34% 3. Neutral	16% 4. Somewhat support	23% 5. Strongly support
Installation of a roundabout at Reed Lane Scored 3.10	24% 1. Strongly oppose	10% 2. Somewhat oppose	27% 3. Neutral	13% 4. Somewhat support	27% 5. Strongly support
Installation of a roundabout at Stillfried Lane Scored 3.17	22% 1. Strongly oppose	9% 2. Somewhat oppose	27% 3. Neutral	14% 4. Somewhat support	28% 5. Strongly support
Installation of a roundabout at Colonnade Drive Scored 3.20	22% 1. Strongly oppose	8% 2. Somewhat oppose	27% 3. Neutral	15% 4. Somewhat support	29% 5. Strongly support
604 respondents					

Figure 3-13. Survey Intersections – Ivy Road - Eastern Corridor Package



Table 3-6 shows the written survey results for the Eastern Corridor Package at the intersections on Ivy Road. It includes the top five keyword mentions and how often the word was mentioned with positive or negative sentiment. 604 people scored the Focus Group Middle Corridor Package, and 181 provided written comments.

Table 3-6. Survey Result – Ivy Road - Eastern Corridor Package

Top Five Mentions		Top Five Positive Comments			Top Five Negative Comments		
Keyword	Total Mentions	Keyword	Positive	Totals Mentions	Keyword	Negative	Total Mentions
Roundabouts	66	Path	23	28	Roundabouts	22	66
Three Notched	29	Use	20	26	Area	6	14
Path	28	Roundabouts	19	66	Traffic	5	23
Use	26	Package	19	21	Roundabout	4	4
Traffic	23	Three Notched Trail	18	19	Median	3	4

VDOT facilities have access to multiple funding sources for transportation improvement projects. Below is a description of the most relevant funding sources for 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, 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 comes from 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 80% of the eligible project costs and requires a minimum 20% local match. It also 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 specified 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:** The recent Infrastructure Investment and Jobs Act (Public Law 117-58) provides additional discretionary grant funding opportunities.

Table 4-1. Ivy Road – Potential Funding Sources

	SMART SCALE	TAP	RS	Locality Funding
Ivy Road	✓	✓	✓	✓

Appendix A – FHWA STEAP

Appendix B – Raw Crash Data

Appendix C – Raw Traffic Counts

Appendix D – Volume Diagrams

Appendix E – Traffic Analysis Results

Appendix F – Public Input Results

Appendix G – Preliminary Cost Estimate