Garner US 70/US 401 —

Garner Station Mechanical Blvd

Feasibility and Impact Analysis

Prepared for

Capitol Area Metropolitan Planning Organization

By

VHB

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The Garner US 70/US 401/Mechanical Boulevard/Garner Station Feasibility and Impact Analysis is a study to examine mid- and long-term solutions to manage congestion and contribute to safe travel at the convergence of US 70 and US 401 near Tryon Road and Mechanical Boulevard/Garner Station Road in Garner, NC. The study area, as shown in Figure 1, is located on the eastern side of Wake County, just southeast of Raleigh. The goal of this study is to develop a prioritized set of multimodal recommendations that can be implemented over time to accommodate future traffic volumes and create a safer junction for all travel modes, while minimizing undesirable impacts to the environment and surrounding land uses. This memorandum presents the existing conditions and trends within and near the study area.

Relevant Plans & Studies

A review of relevant planning and policy efforts was conducted to identify specific elements that may affect the Feasibility and Impact Analysis, or which could be affected by it.

CAMPO 2045 Metropolitan Transportation Plan (MTP)

The CAMPO 2045 MTP is the fiscally constrained long-range plan for transportation improvements across the MPO region. It includes roadway, transit, rail, pedestrian and other transportation projects to be implemented through 2045. Table 1 presents roadway projects within five miles of the project area which may impact the study.

The MTP also includes the following major transit improvement projects in the study area:

- A commuter rail transit (CRT) system with an initial focus linking, Garner, Raleigh, and Cary in Wake County with the Research Triangle Park downtown Durham and West Durham. This project is currently being evaluated as part of a Major Investment Study funded by Wake County and Durham County. This initial phase is scheduled for the 2026 – 2035 time period of this plan.
- A bus rapid transit (BRT) system ultimately connecting Raleigh, Cary, and Garner. These projects and services are currently being evaluated as part of the Major Investment Study funded by Wake and Durham County as well as the Bus Implementation Plan funded by Wake County. The initial phase includes portions of both dedicated fixed guideway as well as mixed traffic BRT service and is scheduled early in the 2026 – 2035 time period of this plan.

State Transportation Improvement Program (STIP)

The STIP is the NC Department of Transportation's 10-year capital improvement plan that identifies the scheduling and funding of construction projects throughout the state. Table 2 presents 2018-2017 STIP projects within five miles of the project area which may impact the study.

Wake Transit Plan

The Wake Transit Plan and dedicated revenue sources were approved by county commissioners and voters in 2016. The plan is a comprehensive study that lays out the strategies needed to link major Wake County communities via an expanded transit service system and it focuses on four "Big Moves" to 1) connect the region; 2) connect all Wake County communities; 3) create a frequent and reliable urban transit network; and 4) provide enhanced access to transit. The plan proposes to develop a greatly expanded frequent bus network, bus service that connects the twelve Wake County municipalities, passenger infrastructure improvements; and the BRT and commuter rail services. These recommendations have been incorporated into CAMPO's 2045 MTP.

Figure 1. Study Area.

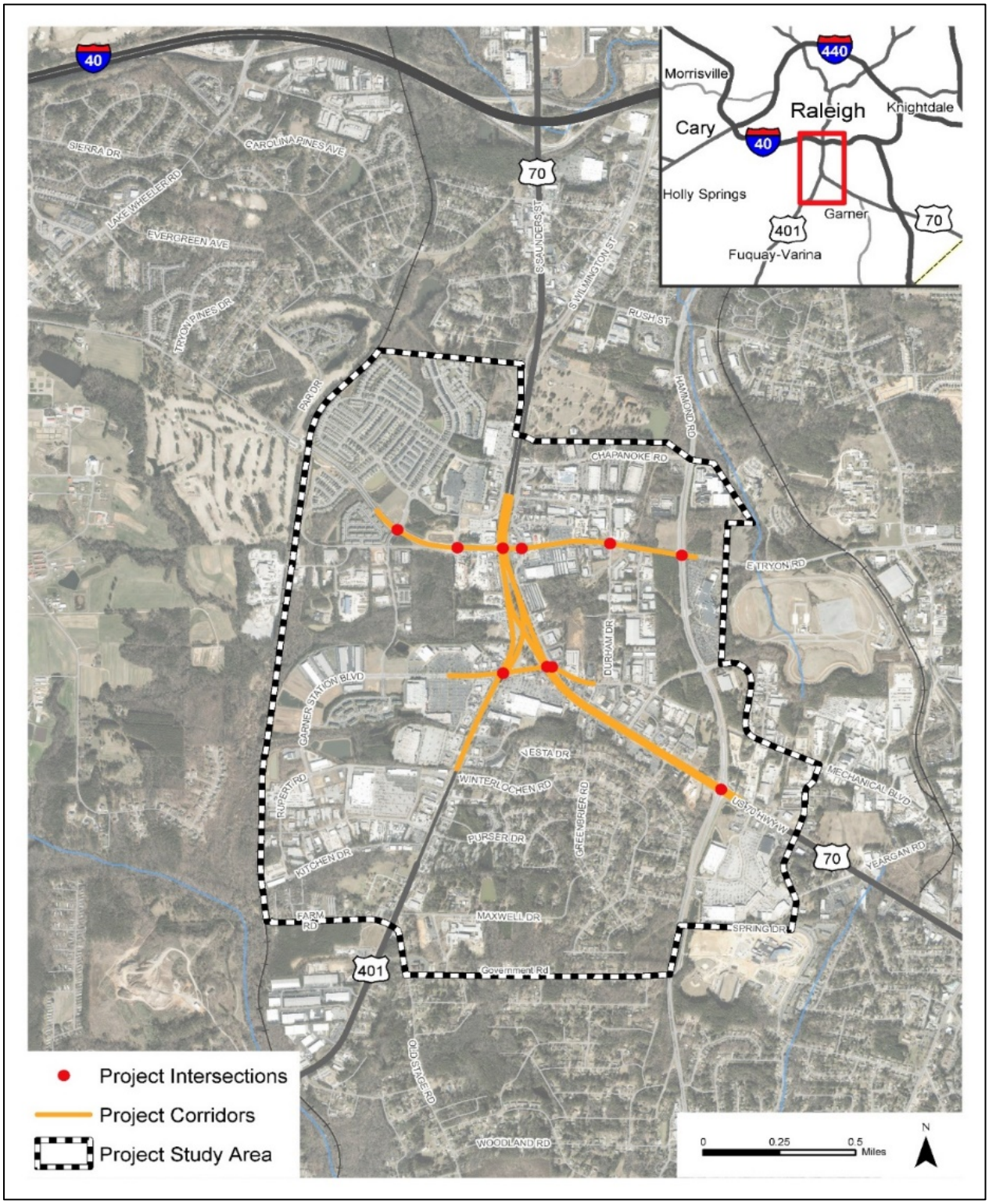


Table 1. Summary of Relevant CAMPO 2045 MTP Projects.

Project ID	Description	Horizon Year	STIP Project
A136b	**Lake Wheeler Road**: Widen to 4 lanes from Tryon Road to Penny Road	2035	n/a
A43	**Lake Wheeler Road:** Widen to 4 lanes from Tryon Road to I-40	2045	n/a
A137a	**Old Stage Road:** Widen to 4 lanes from US 401 to Ten Ten Road	2035	n/a
A46a	**Tryon Road:** Widen to 4 lanes from Lake Wheeler Road to Par Drive	2025	U-3442
A46b	**Tryon Road:** Widen to 4 lanes from Norfolk-Southern Railroad to existing Tryon Road alignment	2025	U-4432
A120	**Tryon Road Extension:** New construction of 4 lanes	2035	U-3111
A139	**US 70 at Timber Road:** Construct new interchange	2025	U-5744
A300	**US 70:** Widen to 6 lanes from US 401 to I-40	2035	n/a
A635a	**US 401 Superstreet:** Superstreet from Garner Station Boulevard to Purser Drive	2035	n/a
A635b	**US 401 Superstreet:** Superstreet from Purser Drive to Legend Road	2035	U-5302
A480a	**US 401 South:** Widen to 6 lanes from US 70 to Ten Ten Road	2035	n/a
A140a	**Vandora Springs Road & Extension:** Widen to 4 lanes from Timber Drive to Old Stage Road	2035	n/a
A140b	**Vandora Springs Road & Extension:** Widen to 4 lanes from Old Stage Road to US 401	2035	n/a

Southern Gateway Corridor Plan

The City of Raleigh's Southern Gateway Corridor Plan, adopted February 2017, focuses on land use and transportation improvements needed along the South Saunders Street and South Wilmington Street corridors that will benefit businesses, residents, motorists, transit users, pedestrian and bicyclists to establish cohesive character and identity to this southern approach into Downtown Raleigh. Recommendations within the study area, which is located at the southern end of the Gateway, include extending South Wilmington Street south as a central spine for new, commercial and transit-oriented development. This would predominantly impact the Tryon Road and South Wilmington Street area. These recommendations have been incorporated into CAMPO's 2045 MTP.

Southeast Area Study

The Southeast Area Study was a collaboration between CAMPO, the Upper Coastal Plain Rural Planning Organization (UCPRPO), and the North Carolina Department of Transportation (NCDOT) to develop transportation priorities for eleven municipalities and unincorporated areas within Wake and Johnston Counties. This study was completed in 2017 and the resulting recommendations within the CAMPO jurisdiction have been incorporated in the 2045 MTP.

Garner Forward Transportation Plan: The *Garner Forward* Transportation Plan, adopted June 2018, is a multimodal transportation plan providing a vision and strategies for future mobility improvements and investments in Garner. Table 3 presents relevant recommendations included in this plan.

Table 2. Summary of Relevant 2017-2018 STIP Projects.

Project ID	Description	Scheduled Construction Year
U-3442	**Tryon Road:** Widen to 4 lanes from Norfolk-Southern Railroad to existing Tryon Road alignment	Under Construction
U-5302	**US 401:** Superstreet from Purser Drive to Legend Road	2020
U-5744	**US 70 at Timber Road:** Construct new interchange	2021
TD-5272	**GoRaleigh Transit:** Construct off-street transfer facility on S. Wilmington Street at Pecan Road	Under Construction
EB-5709	**Martin Luther King Jr. Boulevard (SR 4363):** Construct dedicated bicycle lanes from S. Saunders Street to Poole Road (SR 1007)	In progress by City of Raleigh

Capital Improvement Programs:

A capital improvement program (CIP) is a short-range plan identifying capital projects and equipment needs for a municipality. The CIP typically identifies transportation expenditures to be undertaken by the municipality. Since the study area spans portions of both the City of Raleigh and Town of Garner, the CIPs for both were reviewed for relevant projects, which are summarized below.

- City of Raleigh Capital Improvement Program (Fiscal Years 2015 – 2019)

  In the study area, the City of Raleigh CIP identifies one transportation project – Tryon Road Part C, which is funded at $4,473,000. This project is also included in the CAMPO 2045 MTP as project A46a.

- Town of Garner Capital Improvement Program (Fiscal Years 2017 – 2022)

  No projects were identified within the study area.

Table 3. Relevant Garner Forward Action Plan Recommendations.

Location	Improvement	Time Frame
US 70 from Tryon Road to Timber Drive	Access Management/ Streetscape	2024
Garner Road from Tryon Road to Auburn Knightdale Road	Access Management/ Streetscape	2027
US 70 from Jones Sausage Road to Timber Drive	6-lane divided section	2028
Old Stage Road from Ten-Ten Road to US 401 (access management / streetscape)	Access Management/ Streetscape	2030
US 401 at Old Stage Road	Spot Safety/Hazard Elimination	2035
US 401 from US 70 to the future I-540 interchange	6-lane divided section	2038
Circulator Route (East)	Transit	2023
Circulator Route (West)	Transit	2025
Bus Rapid Transit (BRT)	Transit	2025
Commuter Rail Service (CRT)	Transit	2030

Critical Environmental & Community Features

A screening of environmental and community features was completed for the study area utilizing GIS resources. This screening analysis indicates areas of possible environmental & community concern, as summarized in Table 4, and discussed below.

Human Environment

As depicted in Figures 2 through 5, there are minor instances of poverty, minority, Hispanic and limited English proficiency populations within the study area. No zero-car households were captured as part of this GIS-based screening analysis.

Built Environment

The built environment in the study area is a mix of residential, public and institutional, commercial and industrial land uses. Overall, the study area is medium density.

A review of places of worship in the study area identified fourteen churches and one cemetery, along with one large cemetery (Montlawn Memorial Park) adjacent to the northern study area boundary. One school, Smith Magnet Elementary, is in the study area, and one additional school, Wake Christian Academy, is

located approximately 0.75 miles from the southern limits of the study area. One institution of higher-learning, Care One Healthcare Training Institute, is in the northern study area.

There are numerous underground storage tanks, predominantly associated with gas stations, located along the project corridors and within the study area. Underground storage tanks may pose a potential challenge for redevelopment of these parcels.

There is one major utility easement running southeast through the northern portion of the study area.

The built environment elements are presented in Figure 6.

This GIS-level screening included the following categories associated with the built environment, however, no features were identified within the study area: National Register of Historic Places, State Historic Place Study List, State Local Landmark District, Federally-Owned Lands, State-Owned Lands.

Natural Environment

Much of the study area is located within the Swift Creek (Lake Benson) Water Supply Watershed, as shown in Figure 6. Other natural environment elements identified in the study area and shown on this figure include minor instances of Local Watershed Protection Plan areas, Targeted Local Watershed, Managed Areas, and Private and Public Open Spaces. Also included are moderate instances of Water Supply Watershed areas and Prime Soils.

This GIS-level screening included several categories associated with the natural environment but not present within the study area, which are included in Table 4.

Figure 2. Influence of Poverty within Study Area.

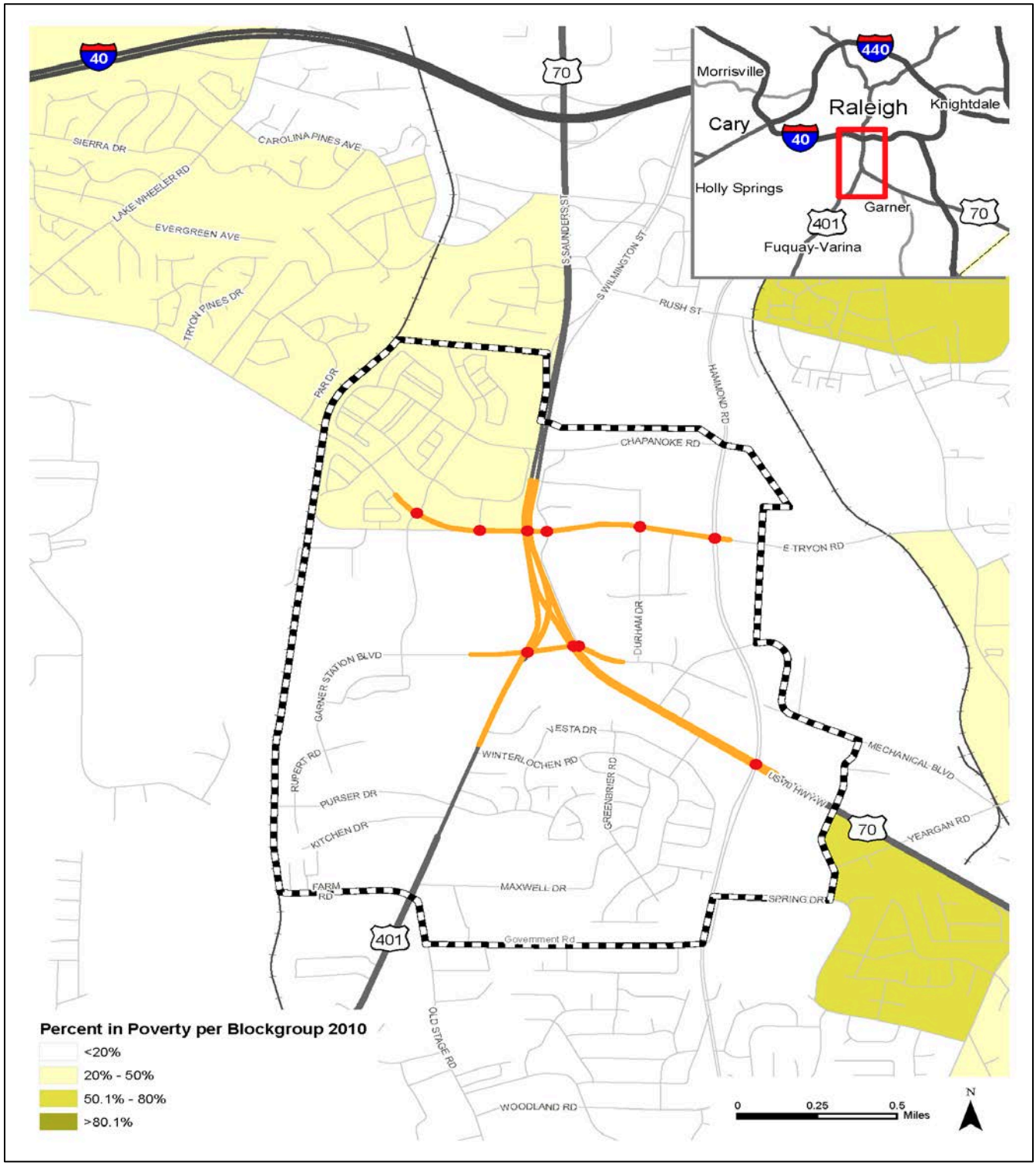


Figure 3. Minority Population within Study Area.

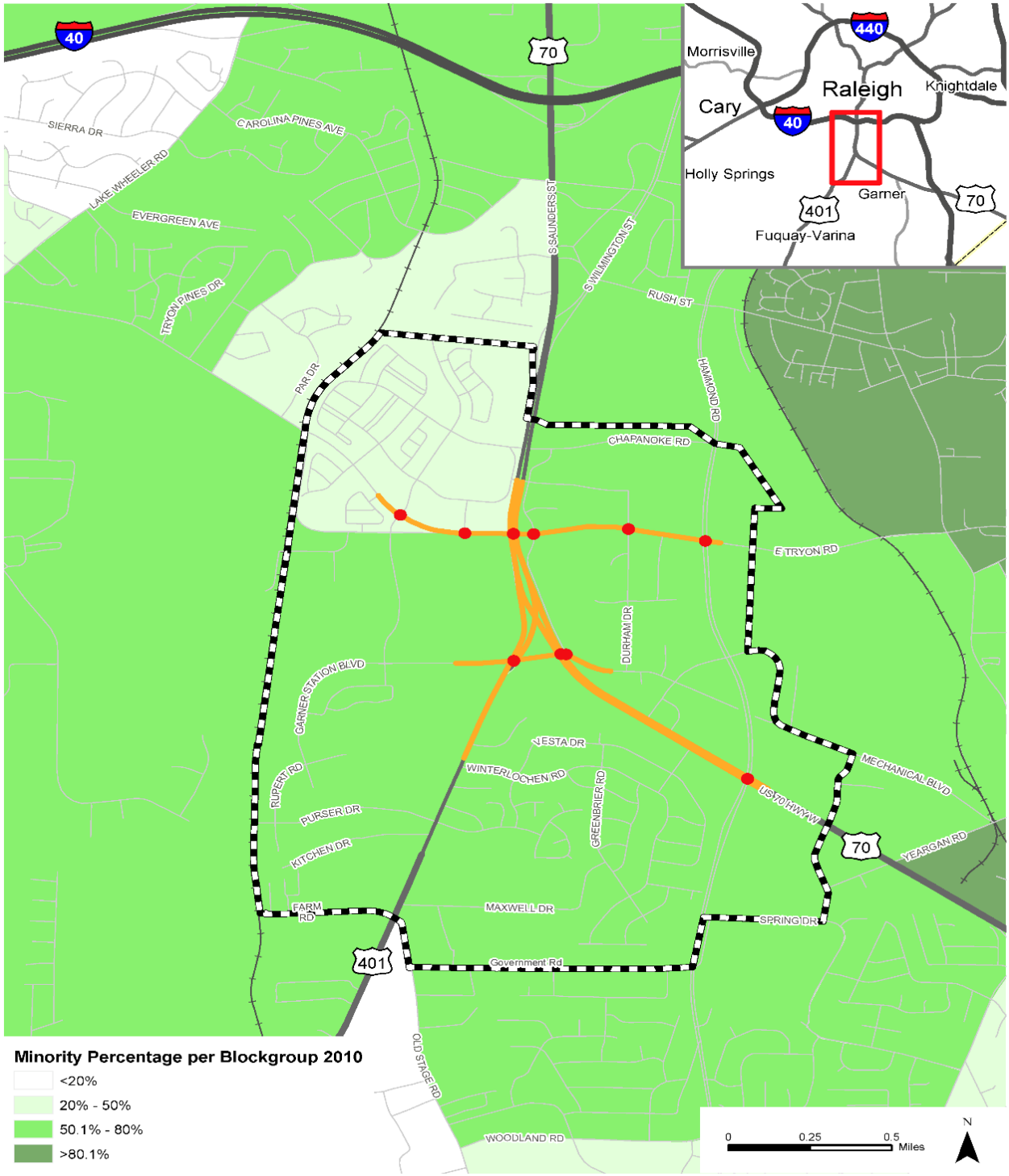


Figure 4. Hispanic Population within the Study Area.

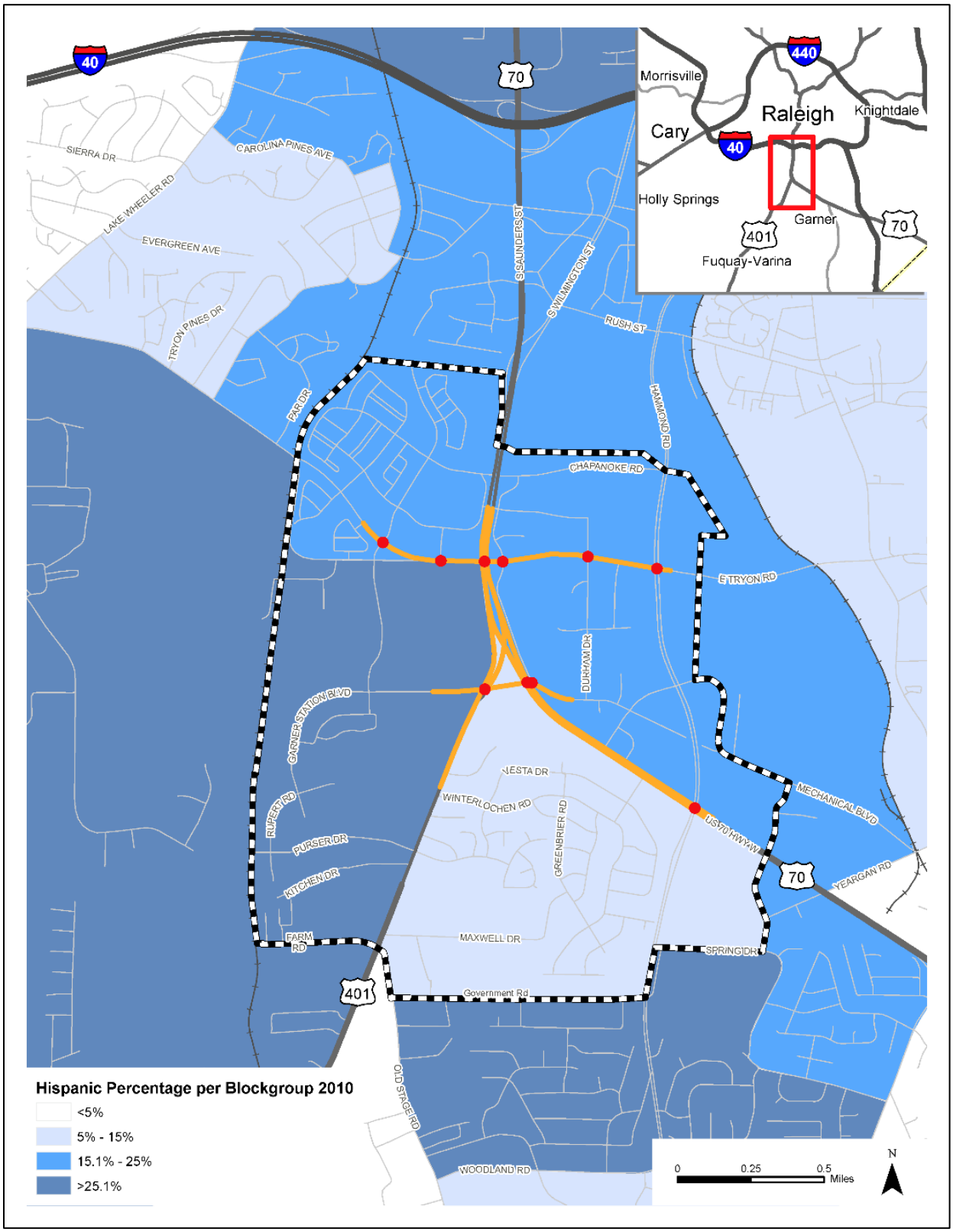


Figure 5. Limited English Proficiency Population within Study Area.

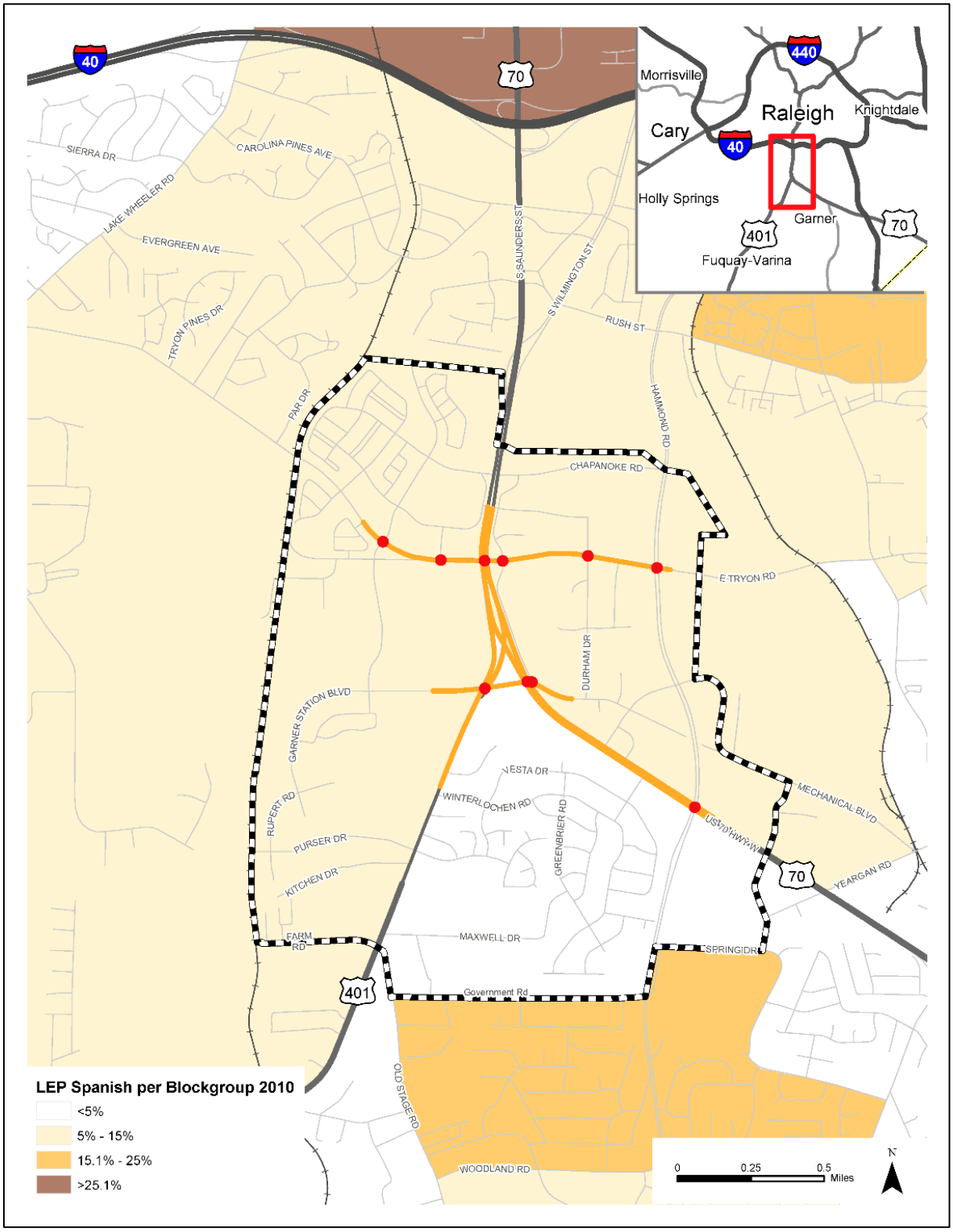


Figure 6. Environmental Resources within Study Area.

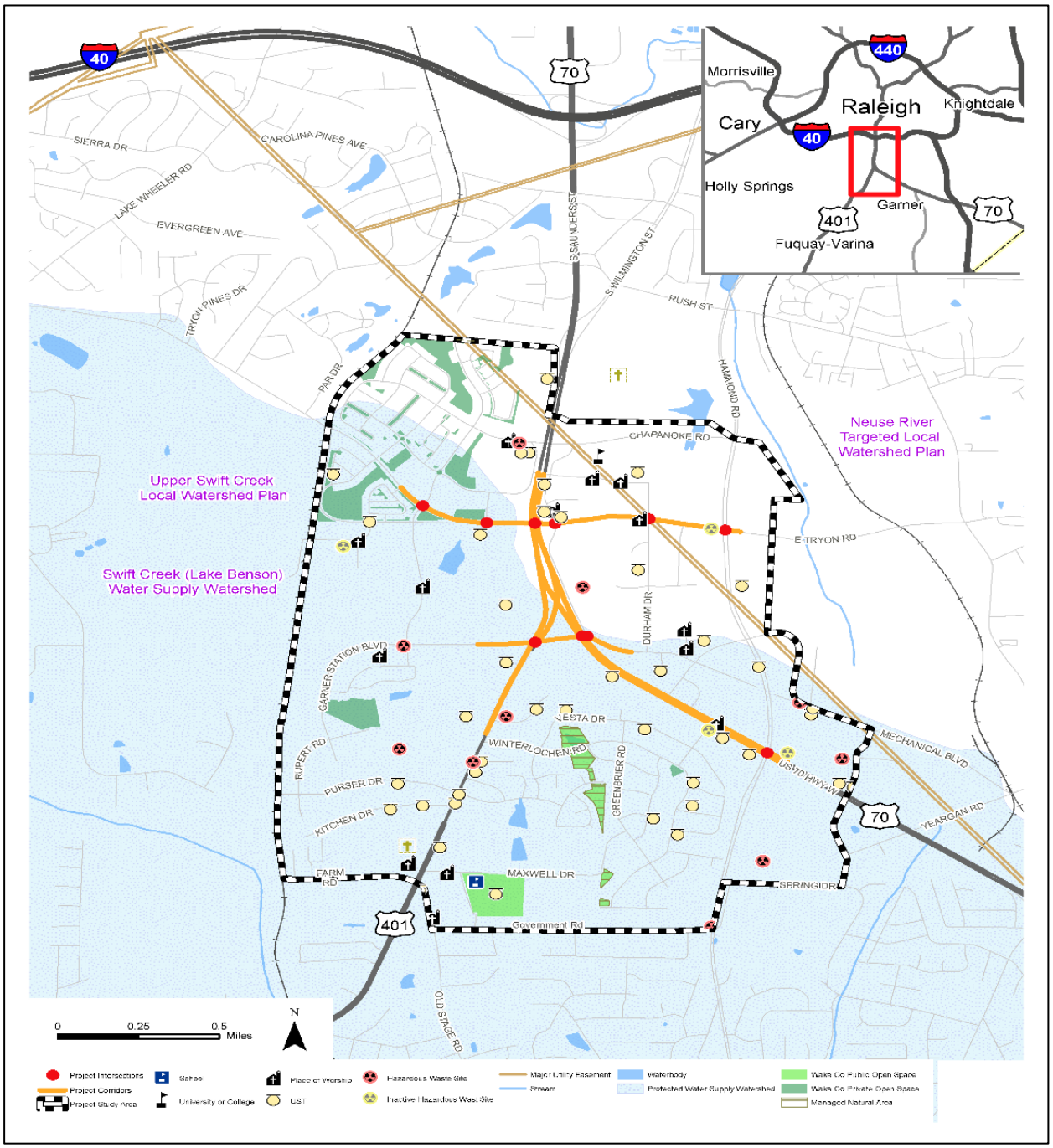


Table 4. Environmental Screening Analysis.

Environmental Screening Factors[1]	**Existing Conditions**	**Shown in Figure 4**
Maximum Possible Score	Mod	
Hydrologic Factors		
Public Water Supply - Well	N/A	N/A
Impaired Stream - 303(d)	N/A	N/A
Stream	N/A	N/A
Major Stream	N/A	N/A
Wetland	N/A	N/A
Waterbody	N/A	N/A
High Quality / Outstanding Resource Waters	N/A	N/A
Hydric Soils	Not Depicted[2]	
Local Watershed Protection Plan	Min	7
Targeted Local Watershed	Min	7
Water Supply Watershed	Mod	7
Environmental Factors		
Prime Soils	Mod	
Landfill Site - Active	N/A	N/A
Landfill Site - Previous	N/A	N/A
Brownfields	N/A	N/A
Hazardous Waste Site	Mod	7
Inactive Hazardous Waste Site	Mod	7
Underground Storage Tank	Mod	7
Access Easement	N/A	N/A
Utility Easement[3]	Min	7
National Pollution Discharge Elimination System Site	N/A	N/A
Hazardous Substance Disposal Site	N/A	N/A
Land Trust Conservation Property	N/A	N/A
Conservation Tax Credit Property	N/A	N/A
Game Lands	N/A	N/A
Managed Areas	Min	7
Natural Heritage Element Occurrence	N/A	N/A
Natural Heritage Natural Area	N/A	N/A
Recreation Factors		
Greenways & Trails	N/A	N/A
Open Space - Private	Min	7
Open Space - Public	Min	7
Historic & Cultural Factors		
Cemetery	Min	7

Environmental Screening Factors[1]	**Existing Conditions**	**Shown in Figure 4**
Church	Mod	7
Schools - Public/Private	Min	7
Colleges and Universities	Min	7
National Register of Historic Places	N/A	N/A
State Historic Place Study List	N/A	N/A
State Local Landmark District	N/A	N/A
Federally-Owned Lands	N/A	N/A
State-Owned Lands	N/A	N/A
Environmental Justice Factors		
Poverty Population	Min	3
Minority Population	Min	4
Hispanic Population	Mod	5
Limited English Proficiency Population	Min	6
Zero Car Households	N/A	N/A

Existing Transportation Network

Roadways

The study corridors, as shown in Figure 1, are defined by the following facilities:

- Tryon Road, from Voltaire Drive through Hammond Road, which varies from four-lanes to five-lanes within the study area.
- Mechanical Boulevard, from US 70 through Hammond Road, which varies from three to five lanes within the study area.
- South Wilmington Street (US 70/US 401), from Sherwee Drive to the US 70/US 401 split, which is an eight-lane divided roadway within the study area.
- US 70, from the US 70/US 401 split to McCormick Drive, which is a four-lane divided roadway within the study area.
- Fayetteville Road (US 401), from the US 70/US 401 split to south of Annaron Drive, which is a five-lane section within the study area.

The following signal-controlled intersections within the study area were analyzed:

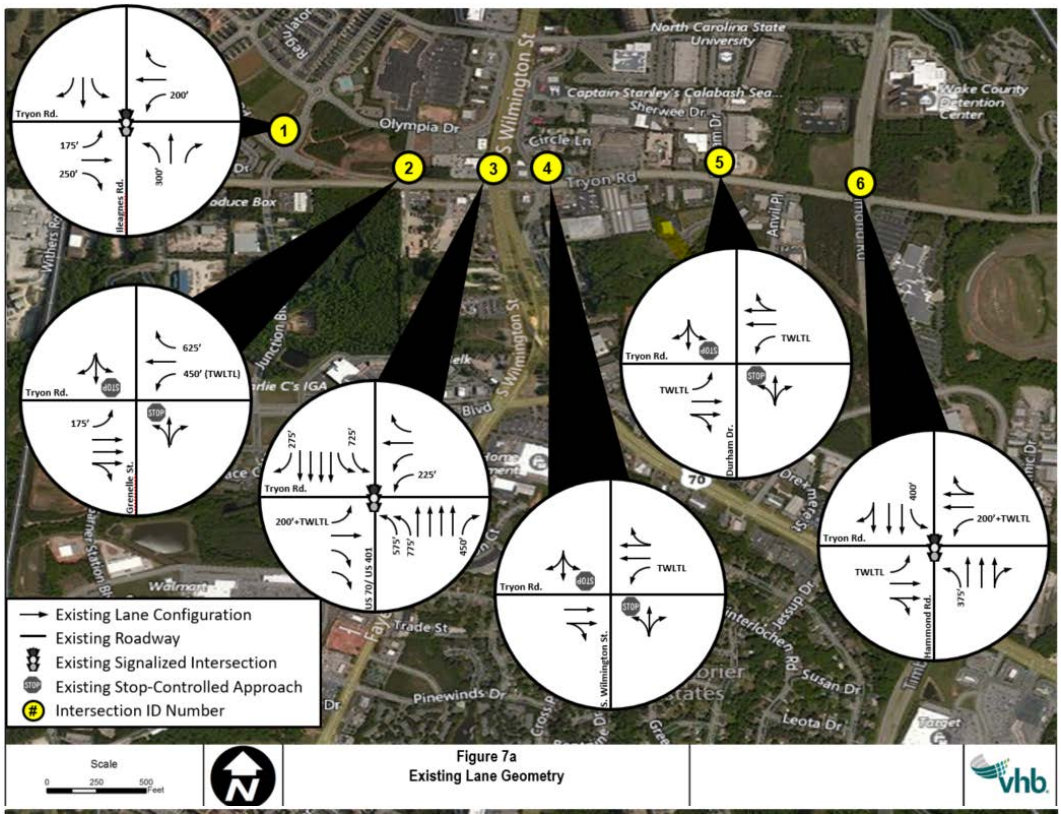
- Tryon Road at Illeagnes Road
- Tryon Road at South Wilmington Street (US 70/US 401)
- Tryon Road at Hammond Road
- Garner Station Road/Mechanical Boulevard at South Wilmington Street (US 70/US 401)
- Mechanical Boulevard at US 70
- Timber Drive at US 70

The following STOP-controlled intersections were also analyzed:

- Tryon Road at Grennelle Street
- Tryon Road at South Wilmington Service Road
- Tryon Road at Durham Drive
- Mechanical Boulevard at South Wilmington Service Road

Figure 7 depicts the existing lane configurations for the ten intersections analyzed.

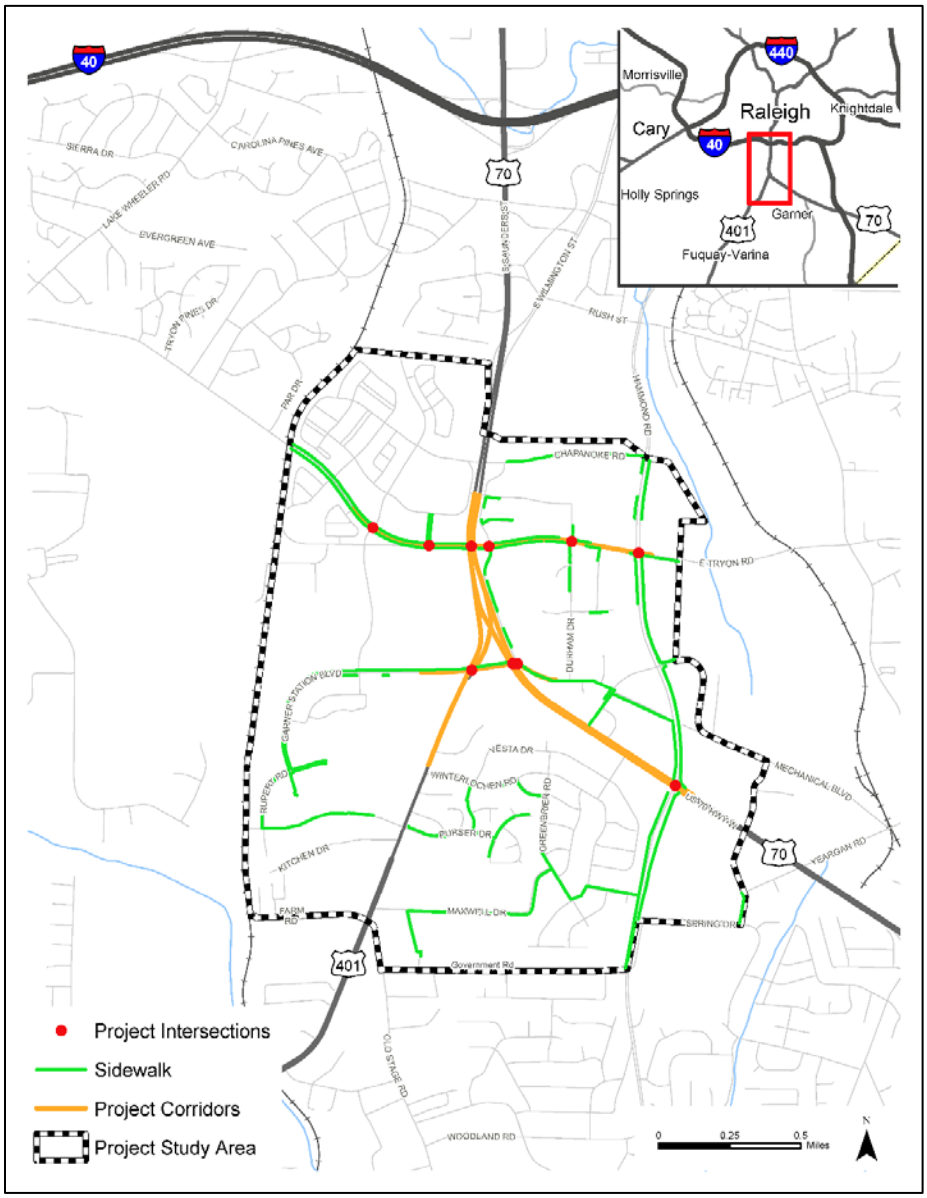
Figure 7. Current 2018 Line Geometries.



Bicycle and Pedestrian

There are no bicycle facilities present within the study area. The network of pedestrian facilities, as shown in Figure 8, is made of up numerous sections of mostly non-contiguous sidewalks.

Figure 8. Pedestrian Facilities within the Study Area.



Transit

GoTriangle and GoRaleigh both operate routes within the study area. A summary of the service provided is presented in Table 5.

Table 5. Transit Service.

System	Route		Operating	Day of Week	Operating Hours	Frequency (min)	
	No.	Name	Along			Peak	Off-Peak
GoRaleigh	7	South Saunders	US 70 Garner Station Blvd US 401	Mon-Fri	5:45am-11:45pm	15	30 or 60
				Saturday	6:00am-11:45pm	30 or 60	
				Sunday	6:00am-10:59pm	30 or 60	
	40X	Wake Tech Express	US 70 Garner Station Blvd US 401 E Tryon Rd	Mon-Fri	6:15am-6:40pm	30 or 60	
				Saturday	No Service		
				Sunday	No Service		
GoTriangle	FRX	Fuquay-Varina - Raleigh Express (Operated by GoRaleigh)	US 70 US 401 (This is a through route that does not stop in Garner)	Mon-Fri	Peak Service Only		
				Saturday	No Service		
				Sunday	No Service		
	102	Garner - Downtown Raleigh (Operated by GoRaleigh)	Hammond Road/ Timber Drive	Mon-Fri	Peak Service Only		
				Saturday	No Service		
				Sunday	No Service		

Traffic & Crash Data

Traffic Volumes (Historic AADTs & Field Data Collection)

NCDOT's traffic count program provides a consistent source of data for assessing traffic volume trends over time. There are 13 count stations within the study limits where counts are taken semi-annually. Table 6 summarizes counts at these stations between 2003 and 2015.

Table 6. Historic AADTs.

Label	ID	Road Name			Historical AADT						
		Intersection Location	Route	Selected Segment	2003	2005	2007	2009	2011	2013	2015
N	201	SR 1370 (Tryon Road) at Grenelle Street	Grenelle Street	North of SR 1370 (Tryon Road)							
E			SR 1370 (Tryon Road)	East of Grenelle Street	9,900	12,000	13,000	13,000	13,000	14,000	15,000
S			Grenelle Street	South of SR 1370 (Tryon Road)							
W			SR 1370 (Tryon Road)	West of Grenelle Street							
N	301	US 70/US 401 (S Wilmington Street) at SR 1370/2684 (Tryon Road)	US 70/US 401 (Wilmington Street)	North of SR 2684 (Tryon Road)	53,000	53,000	51,000	53,000	48,000	48,000	59,000
E			SR 2684 (Tryon Road)	East of US 70/US 401 (Wilmington Street)							
S			US 70/US 401 (Wilmington Street)	South of SR 2684 (Tryon Road)	63,000	67,000	60,000	65,000	55,000	57,000	
W			SR 1370 (Tryon Road)	West of US 70/US 401 (Wilmington Street)	9,900	12,000	13,000	13,000	13,000	14,000	15,000

Label	ID	Road Name			Historical AADT						
		Intersection Location	**Route**	**Selected Segment**	**2003**	**2005**	**2007**	**2009**	**2011**	**2013**	**2015**
N	**601**	**SR 2684 (Tryon Road) at SR 2026 (Hammond Road)**	SR 2026 (Hammond Road)	North of SR 2684 (Tryon Road)	24,000	24,000	25,000	23,000	22,000	23,000	23,000
E			SR 2684 (Tryon Road)	East of SR 2026 (Hammond Road)							
S			SR 2026 (Hammond Road)	South of SR 2684 (Tryon Road)							
W			SR 2684 (Tryon Road)	West of SR 2026 (Hammond Road)	10,000	11,000	12,000	11,000	11,000	11,000	12,000
N	**701**	**US 401 (Fayetteville Road) at SR 2538 (Mechanical Boulevard)**	US 401 (Fayetteville Road)	North of SR 2538 (Mechanical Boulevard)							
E			SR 2538 (Mechanical Boulevard)	East of US 401 (Fayetteville Road)	11,000	12,000	12,000	11,000	10,000	10,000	13,000
S			US 401 (Fayetteville Road)	South of SR 2538 (Mechanical Boulevard)	38,000	41,000	41,000	44,000	40,000	40,000	42,000
W			Garner Station Boulevard	West of US 401 (Fayetteville Road)							

Label	ID	Road Name			Historical AADT						
		Intersection Location	**Route**	**Selected Segment**	**2003**	**2005**	**2007**	**2009**	**2011**	**2013**	**2015**
N	**801**	**US 70 at SR 2538 (Mechanical Boulevard)**	US 70/US 401 (Wilmington Street)	North of SR 2538 (Mechanical Boulevard)							
E			SR 2538 (Mechanical Boulevard)	East of US 70/US 401 (Wilmington Street)							
S			US 70/US 401 (Wilmington Street)	South of SR 2538 (Mechanical Boulevard)	33,000	31,000	33,000	32,000	29,000	30,000	33,000
W			SR 2538 (Mechanical Boulevard)	West of US 70/US 401 (Wilmington Street)	11,000	12,000	12,000	11,000	10,000	10,000	13,000
N	**901**	**US 70 at SR 2026 (Hammond Road)/ SR 2812 (Timber Drive)**	SR 2026 (Hammond Road)	North of US 70	18,000	18,000	19,000	17,000	17,000	18,000	18,000
E			US 70	East of SR 2026 (Hammond Road)	32,000	32,000	33,000	31,000	31,000	30,000	32,000
S			SR 2812 (Timber Drive)	South of US 70	20,000	20,000	22,000	19,000	18,000	19,000	21,000
W			US 70	West of SR 2026 (Hammond Road)							

Additional counts were collected by VHB in March 2018 and then adjusted using the appropriate NCDOT seasonal and day-of-week factors to obtain annual daily traffic volumes (AADTs). These volumes were then smoothed and balanced for continuity between intersections, and factored to generate peak-period turning movements. Table 7 summarizes the results of this process. Figure 9 summarizes the resulting peak hour (AM and PM) turning movement volumes used for level-of-service analysis.

Table 7. 2018 Traffic Counts.

Label	ID	Road Name			TMC/Class Count		16 Hour Count	16 Hr to Daily Factor	NCDOT Seasonal Factors		Annualized Daily Count	Estimated AADT
		Intersection Location	Route	Selected Segment	Date	Day			ATR Group	Factor		
N	101	SR 1370 (Tryon Road) at Ileagnes Road	Ileagnes Road	North of SR 1370 (Tryon Road)	2/13/2018	Tuesday	1,648	0.93	4	0.94	1,664	1,700
E			SR 1370 (Tryon Road)	East of Ileagnes Road			14,793	0.93	4	0.94	14,936	14,900
S			Ileagnes Road	South of SR 1370 (Tryon Road)			6,687	0.93	4	0.94	6,752	6,800
W			SR 1370 (Tryon Road)	West of Ileagnes Road			15,768	0.93	4	0.94	15,920	15,900
N	201	SR 1370 (Tryon Road) at Grenelle Street	Grenelle Street	North of SR 1370 (Tryon Road)	2/13/2018	Tuesday	1,799	0.93	4	0.94	1,816	1,800
E			SR 1370 (Tryon Road)	East of Grenelle Street			15,160	0.93	4	0.94	15,307	15,300
S			Grenelle Street	South of SR 1370 (Tryon Road)			490	0.93	4	0.94	495	500
W			SR 1370 (Tryon Road)	West of Grenelle Street			14,983	0.93	4	0.94	15,128	15,100

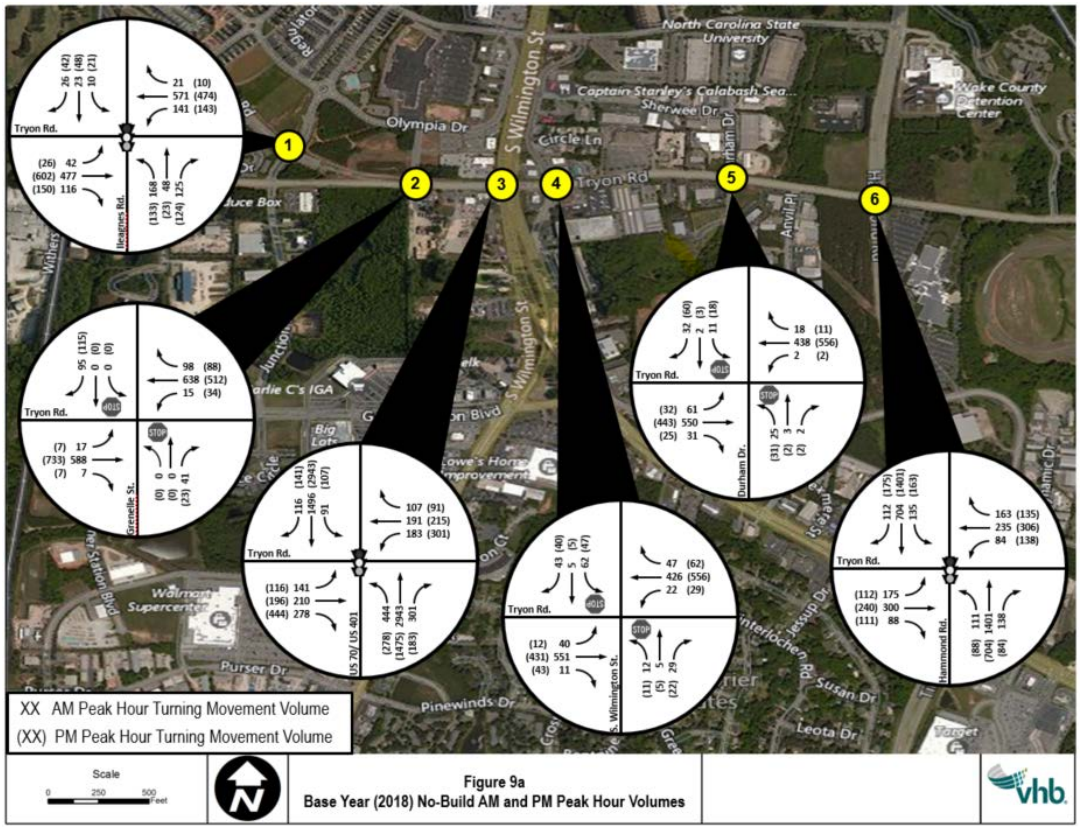
Label	ID	Road Name			TMC/Class Count		16 Hour Count	16 Hr to Daily Factor	NCDOT Seasonal Factors		Annualized Daily Count	Estimated AADT
		Intersection Location	Route	Selected Segment	Date	Day			ATR Group	Factor		
N	**301**	**US 70/US 401 (S Wilmington Street) at SR 1370/2684 (Tryon Road)**	US 70/US 401 (Wilmington Street)	North of SR 2684 (Tryon Road)	2/13/2018	Tuesday	59,864	0.93	4	0.94	60,704	60,700
E			SR 2684 (Tryon Road)	East of US 70/US 401 (Wilmington Street)			12,071	0.93	4	0.94	12,188	12,200
S			US 70/US 401 (Wilmington Street)	South of SR 2684 (Tryon Road)			69,003	0.93	4	0.94	69,971	70,000
W			SR 1370 (Tryon Road)	West of US 70/US 401 (Wilmington Street)			15,356	0.93	4	0.94	15,504	15,500
N	**401**	**SR 2684 (Tryon Road) at S Wilmington Street**	S Wilmington Street	North of SR 2684 (Tryon Road)	2/13/2018	Tuesday	2,918	0.93	4	0.94	2,946	2,900
E			SR 2684 (Tryon Road)	East of S Wilmington Street			11,335	0.93	4	0.94	11,445	11,400
S			S Wilmington Street	South of SR 2684 (Tryon Road)			1,178	0.93	4	0.94	1,189	1,200
W			SR 2684 (Tryon Road)	West of S Wilmington Street			11,885	0.93	4	0.94	12,000	12,000

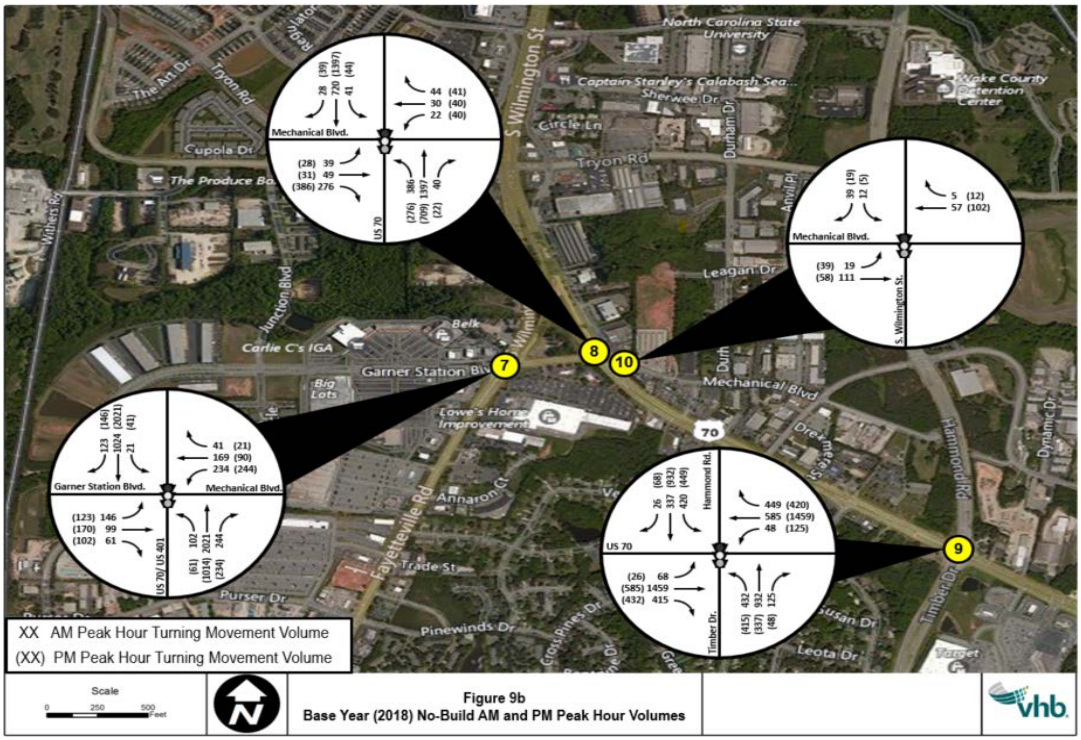
Label	ID	Road Name			TMC/Class Count		16 Hour Count	16 Hr to Daily Factor	NCDOT Seasonal Factors		Annualized Daily Count	Estimated AADT
		Intersection Location	Route	Selected Segment	Date	Day			ATR Group	Factor		
N	**501**	**SR 2684 (Tryon Road) at Durham Drive**	Durham Drive	North of SR 2684 (Tryon Road)	2/13/2018	Tuesday	1,241	0.93	4	0.94	1,253	1,300
E			SR 2684 (Tryon Road)	East of Durham Drive			11,219	0.93	4	0.94	11,327	11,300
S			Durham Drive	South of SR 2684 (Tryon Road)			735	0.93	4	0.94	742	700
W			SR 2684 (Tryon Road)	West of Durham Drive			10,885	0.93	4	0.94	10,990	11,000
N	**601**	**SR 2684 (Tryon Road) at SR 2026 (Hammond Road)**	SR 2026 (Hammond Road)	North of SR 2684 (Tryon Road)	2/13/2018	Tuesday	24,309	0.93	4	0.94	24,544	24,500
E			SR 2684 (Tryon Road)	East of SR 2026 (Hammond Road)			11,693	0.93	4	0.94	11,806	11,800
S			SR 2026 (Hammond Road)	South of SR 2684 (Tryon Road)			22,688	0.93	4	0.94	22,907	22,900
W			SR 2684 (Tryon Road)	West of SR 2026 (Hammond Road)			11,356	0.93	4	0.94	11,466	11,500

Label	ID	Road Name			TMC/Class Count		16 Hour Count	16 Hr to Daily Factor	NCDOT Seasonal Factors		Annualized Daily Count	Estimated AADT
		Intersection Location	Route	Selected Segment	Date	Day			ATR Group	Factor		
N	**701**	**US 401 (Fayetteville Road) at SR 2538 (Mechanical Boulevard)**	US 401 (Fayetteville Road)	North of SR 2538 (Mechanical Boulevard)	2/13/2018	Tuesday	41,665	0.93	4	0.94	42,249	42,200
E			SR 2538 (Mechanical Boulevard)	East of US 401 (Fayetteville Road)			11,009	0.93	4	0.94	11,115	11,100
S			US 401 (Fayetteville Road)	South of SR 2538 (Mechanical Boulevard)			45,474	0.93	4	0.94	46,112	46,100
W			Garner Station Boulevard	West of US 401 (Fayetteville Road)			8,552	0.93	4	0.94	8,635	8,600
N	**801**	**US 70 at SR 2538 (Mechanical Boulevard)**	US 70/US 401 (Wilmington Street)	North of SR 2538 (Mechanical Boulevard)	2/13/2018	Tuesday	27,961	0.93	4	0.94	28,353	28,400
E			SR 2538 (Mechanical Boulevard)	East of US 70/US 401 (Wilmington Street)			2,351	0.93	4	0.94	2,374	2,400
S			US 70/US 401 (Wilmington Street)	South of SR 2538 (Mechanical Boulevard)			35,375	0.93	4	0.94	35,871	35,900
W			SR 2538 (Mechanical Boulevard)	West of US 70/US 401 (Wilmington Street)			11,581	0.93	4	0.94	11,693	11,700

Label	ID	Road Name			TMC/Class Count		16 Hour Count	16 Hr to Daily Factor	NCDOT Seasonal Factors		Annualized Daily Count	Estimated AADT
		Intersection Location	Route	Selected Segment	Date	Day			ATR Group	Factor		
N	**901**	**US 70 at SR 2026 (Hammond Road)/ SR 2812 (Timber Drive)**	SR 2026 (Hammond Road)	North of US 70	2/13/2018	Tuesday	20,086	0.93	4	0.94	20,280	20,300
E			US 70	East of SR 2026 (Hammond Road)			37,949	0.93	4	0.94	38,481	38,500
S			SR 2812 (Timber Drive)	South of US 70			20,596	0.93	4	0.94	20,795	20,800
W			US 70	West of SR 2026 (Hammond Road)			36,809	0.93	4	0.94	37,325	37,300
N	**1001**	**SR 2538 (Mechanical Boulevard) at S Wilmington Street**	S Wilmington Street	North of SR 2538 (Mechanical Boulevard)	2/13/2018	Tuesday	744	0.93	4	0.94	751	800
E			SR 2538 (Mechanical Boulevard)	East of S Wilmington Street			2,211	0.93	4	0.94	2,242	2,200
S												
W			SR 2538 (Mechanical Boulevard)	West of S Wilmington Street			2,351	0.93	4	0.94	2,384	2,400

Figure 9. Base Year (2018) No-Build AM and PM Peak Hour Volumes





AADTs on Tryon Road range from 11,400 – 15,700 vehicles per day (vpd) along the study corridor, with the highest values at the northern intersection with Illeagnes Road and the lowest to the south at Hammond Road (SR 2026). Observed growth along this section of Tryon Road has ranged between approximately 1% and 3% annually since 2011.

AADTs on Mechanical Boulevard range from 2,200 – 11,400 vpd along the study corridor. The highest volumes are at the intersection with US 70 and the lowest volumes are at the intersection with Wilmington Street. Observed growth along Mechanical Boulevard has varied considerably, ranging between 1% and 7% annually since 2011.

AADTs on US 70/US 401 within the study area range from 60,700 – 70,000 vpd prior to the split between US 70 and US 401. South from the split, AADTs on US 70 within the study area range from 28,100 – 38,600 vpd, with the highest volumes at the Hammond Road intersection. AADTs on US 401 south of the split range from 41,900 – 46,100 vpd. Annual growth along US 70/US 401 has ranged between approximately 3% and 5% since 2011, while growth along US 70 and US 401 after the split has been less dramatic, averaging around 1% annually.

Safety Concerns

The study area contains multiple major signalized intersections, as well as freeway merge and diverge segments, all within less than a one-mile stretch. The combination of these features can cause a higher number of collisions than what might be an average rate along a US Route in the state of North Carolina. General crash trends were observed for US 70 (South Wilmington Street) and US 401 (Fayetteville Road) to summarize safety issues that may need to be addressed.

- US 70 (South Wilmington Street): The area of interest for US 70 begins at the intersection with Sherwee Drive and continues south past the diverge with US 401 to the intersection with McCormick Street. This corridor has two signalized intersections and multiple ramp movements to and from US 401. Major signalized intersections can cause many rear end collisions when placed along high-speed multilane facilities. At the intersection with Tryon Road, US 70 is made up of seven individual lanes (through and turn lanes) in each direction, which increases opportunities for rear-end collisions. The ramps from US 70 to US 401 are located less than a quarter of a mile from the signalized intersection at Tryon Road. The short section can cause a weaving pattern from vehicles needing to cross lanes between Tryon Road and the US 401 ramps. The weaving section can cause a number of sideswipe and angle crashes as vehicles cross paths with each other while speeding up and slowing down.

  After a preliminary view of crash data for the US 70 corridor, the majority of crashes that occurred were rear-ends, followed by sideswipe and angle collisions. The largest number of crashes were located at the signals at Tryon Road and Mechanical Boulevard. Signals within a higher-speed corridor can cause vehicles to slow down suddenly and increase their risk for rear-end collisions.

  One fatality occurred within the study area between January 1, 2013 and December 31, 2017. The incident was located between the intersections of Tryon Road and Mechanical Boulevard. The crash involved a motorcycle travelling at a high rate of speed, exiting the travel lane, and striking a tree adjacent to the roadway. The tree was less than 20 feet from the travel lane.

In total, three pedestrian incidents occurred during the study period. All three involved pedestrians attempting to cross US 70 before being struck by a vehicle. Through the study area, there are no crosswalks present at either of the signals located along US 70, nor are there any sidewalks for pedestrians use.

- US 401 (Fayetteville Road): The section of US 401 being analyzed begins at the split with US 70 and runs south to the intersection with Annaron Court. The short corridor begins with two ramp connections between US 70 and US 401 and includes a signalized intersection at Garner Station Boulevard/Mechanical Boulevard. The signal is located approximately a quarter of a mile south of the ramp connections, and the close proximity could lead to a higher number of rear-end collisions. Vehicles unsuspecting of the signal could be travelling at a higher rate of speed from US 70 and then need to make a sudden stop.

  South of the signalized intersection, US 401 is an undivided roadway with a minimum of two through lanes and a two-way left-turn lane. Uncontrolled access along this segment can increase the risk for left-turn, sideswipe, and angle crashes. Head-on collisions may also occur more frequently as vehicles can cross paths more easily with the two-way left-turn lane present. Median divided facilities are known to reduce the number and severity of crashes for a given corridor. Without a median, a left-turning vehicle onto US 401 could face up to ten conflict points while making that turning movement. When access is restricted, vehicles are only able to turn right, facing only up to two conflict points.

  After a preliminary review of crash data for the US 401 corridor, the majority of crashes that occurred were rear-end collisions. The signal at Garner Station Boulevard, as well as the many commercial driveways south of the intersection, cause many slowdowns along US 401, leading to a higher number of rear-end collisions. Additionally, many sideswipe crashes occurred during the study period analyzed.

  There were two fatalities reported along US 401 between January 1, 2013 and December 31, 2017. The first incident occurred approximately 650 feet north of the intersection with Garner Station Boulevard. The operator of a motorcycle lost control of his vehicle and struck an utility pole less than 10 feet from the roadway. The second incident involved a pedestrian attempting to cross US 401 from the Lowe's parking lot directly south of the intersection with Garner Station Boulevard. Currently, pedestrian facilities are not located at the intersection of US 401 and Garner Station Boulevard or along either side of US 401 in this area. Based on existing conditions, there are no safe crossings present for pedestrian use.

- Tryon Road: Tryon Road was analyzed from the intersection at Ileagnes Road to the intersection with Hammond Road. Through this section of Tryon Road, the roadway is a four-lane divided facility west of US 70 and a five-lane facility with a two-way left-turn lane east of US 70. As mentioned previously, roads with a center two-way left-turn lane are likely to see more collisions than those with a median. The roadway does have multiple major signalized intersections at US 70 and Ileagnes Road. Trends in crash data show many angle crashes at the intersection of US 70 and Tryon Road. Also, the number of sideswipe and rear-end collisions is higher for Tryon Road west of US 70 than east of US 70.

In total, two pedestrian incidents occurred over the study period along Tryon Road. One pedestrian was struck walking east of Durham Drive along a section with no sidewalk. Another pedestrian was struck while crossing Tryon Road east of US 70. There are no crosswalks present along Tryon Road east of US 70 that would assist pedestrians crossing Tryon Road. Also, sidewalks currently end along Tryon Road at the Wilmington Street service road, so pedestrians are not able to easily access available crosswalks at US 70. In addition to the pedestrian incidents, there was one fatal incident between January 1, 2013 and December 31, 2017 along Tryon Road east of US 70. The incident involved a motorcycle striking a vehicle exiting a parking lot a little less than a quarter of a mile from US 70 causing the driver of the motorcycle to be ejected from the vehicle.

It is important to note that the configuration of Tryon Road between Ileagnes Road and US 70 was altered between May of 2015 and May of 2017. The road changed from a two-lane cross section to four-lane divided facility resulting from a roadway improvement project. These changes in the roadway may have affected the crash history of Tryon Road during the study period.

Existing Transportation Conditions Assessment (Deficiency Analysis)

There are several ways to measure the performance of a transportation facility. Transportation professionals typically rely on guidance from the *Highway Capacity Manual*, which describes performance from the traveler's point of view that is designed to be useful to roadway operators, decision makers, and community members. Individuals may travel along or across the study corridors via personal vehicle, walking, bicycling, or via transit. The current dominant form of transportation on the study corridors is automobile. As a result, this section reports traffic conditions within the study area on a corridor basis, as well as by individual intersections. Given the low volume of pedestrian and bicycle trips and the lack of dedicated facilities for these modes, providing a meaningful assessment of bicycle and pedestrian level-of-service is difficult; however, deficiencies and opportunities can be identified, and subsequently addressed with appropriate improvements.

Traffic level of service (LOS) is a quality measure describing operational conditions within a traffic stream. Six levels of service are defined with letters designating each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. Generally, LOS D is acceptable in most rural or suburban situations. In highly urbanized settings, or where there are unacceptable environmental/community impacts, excessive costs or other policy/planning objectives, LOS E may be appropriate.

Intersection Levels of Service

Peak hour LOS measures the adequacy of intersection geometrics and traffic controls of a particular intersection or approach for the given turning movement volumes. LOS at intersections is based on the average control delay experienced by vehicles traveling through the intersection during the peak hour. Control delay is the portion of total delay attributed to traffic control devices (signals or stop signs).

Typically, LOS D is an acceptable operating condition for signalized intersections in urban areas; while LOS C is appropriate in rural areas. At unsignalized intersections, LOS E is considered acceptable only if the side street encounters delay. Nevertheless, side streets sometimes function at LOS F during peak traffic periods; however, the traffic volumes often do not warrant signalization to assist side street traffic.

Table 8 presents a summary of that existing level of service analysis. All unsignalized intersections currently operate at acceptable levels of service. While there are a few intersection approaches operating at LOS E or worse, the only signalized intersection that is currently operating at an unacceptable LOS is the Garner Station Boulevard / Mechanical Boulevard/US 70/US 401 intersection. This intersection is currently operating at a LOS E for the PM peak. Several signalized intersections operating at LOS C or D do have approaches that experience LOS E or F at certain peak periods.

Weaving

A weaving section exists where two significant traffic streams cross each other's path at grade over a length of highway. The weaving segment is subject to significant lane-changing activity, as drivers maneuver from their arrival leg to the desired departure leg. When the traffic demand exceeds the capacity at weaving areas, congestion may occur, which can affect the operation of the entire roadway section. Traffic operational problems also may exist at weaving areas even when traffic demands are less than capacity because of the complexity of vehicle interactions, resulting in poor LOS and potential safety problems.

Table 8. 2018 Level of Service Results Summary.

ID	Intersection and Approach	Traffic Control	Base Year (2018) No-Build	
			AM	PM
101	**Tryon Road and Ileagnes Road**	Signalized	**C (26.8 sec/veh)**	**C (20.6 sec/veh)**
	Eastbound		C-22.0	B-18.7
	Westbound		B-14.5	B-18.6
	Northbound		E-59.4	C-28.7
	Southbound		D-44.9	C-24.4
201	**Tryon Road and Grenelle Street**	Unsignalized	**A (1.3 sec/veh)**	**A (1.3 sec/veh)**
	Eastbound		--0.3	--0.1
	Westbound		--0.2	--0.5
	Northbound		B-10.8	B-11.4
	Southbound		B-11.7	B-11.1
301	**Tryon Road and US 70 / US 401**	Signalized	**C (30.0 sec/veh)**	**D (39.0 sec/veh)**
	Eastbound		D-45.5	E-56.5
	Westbound		E-71.5	F-81.2
	Northbound		B-16.0	C-22.0
	Southbound		D-43.0	D-37.1
401	**Tryon Road and S Wilmington Road**	Unsignalized	**A (3.9 sec/veh)**	**A (3.6 sec/veh)**
	Eastbound		--0.8	--1.1
	Westbound		--0.4	--0.4
	Northbound		C-18.7	C-19.1
	Southbound		D-30.7	D-32.4
501	**Tryon Road and Durham Road**	Unsignalized	**A (1.8 sec/veh)**	**A (2.1 sec/veh)**
	Eastbound		--0.8	--0.6
	Westbound		--0.0	--0.0
	Northbound		D-29.5	D-25.9
	Southbound		C-15.1	C-15.9

ID	Intersection and Approach	Traffic Control	Base Year (2018) No-Build	
			AM	PM
601	**Tryon Road and Hammond Road**	Signalized	**D (37.9 sec/veh)**	**D (40.1 sec/veh)**
	Eastbound		D-47.9	D-54.0
	Westbound		E-66.5	E-62.0
	Northbound		C-33.0	C-31.8
	Southbound		C-25.9	C-33.3
701	**Garner Station Boulevard / Mechanical Boulevard and US 70 / US 401**	Signalized	**D (35.1 sec/veh)**	**E (63.4 sec/veh)**
	Eastbound		E-69.2	E-60.5
	Westbound		D-54.6	E-67.4
	Northbound		D-38.9	C-20.0
	Southbound		B-11.1	F-89.0
801	**Mechanical Boulevard and US 70**	Signalized	**B (16.3 sec/veh)**	**C (22.4 sec/veh)**
	Eastbound		C-26.4	D-41.0
	Westbound		D-39.5	D-48.5
	Northbound		B-14.2	B-13.7
	Southbound		B-13.5	C-20.6
901	**US 70 and Timber Drive / Hammond Road**	Signalized	**D (52.4 sec/veh)**	**D (50.2 sec/veh)**
	Eastbound		D-47.8	C-34.4
	Westbound		D-35.3	D-42.4
	Northbound		E-57.6	E-55.8
	Southbound		E-77.9	E-69.2
1001	**Mechanical Boulevard and S Wilmington Street**	Unsignalized	**A (2.5 sec/veh)**	**A (2.2 sec/veh)**
	Eastbound		--1.1	--3.0
	Westbound		--0.0	--0.0
	Northbound		---	---
	Southbound		A-9.2	A-9.3

Critical Issues

Safety

Analysis of the study area crash history described earlier emphasizes the connection between crashes and roadway design, as well as adjacent land use context. Given the range of crash types, and the concentration of certain crash types at specific locations, various countermeasures must be considered to determine the most appropriate courses of action. That said, several predominant factors and potential mitigations can be identified.

- The segments of US 70 and US 401 that transition from higher-speed, expressway-like facilities (complete with ramps and flyovers) to congested, signal-controlled arterials exhibit high rates of rear-end collisions. The Tryon Road intersection is an example of this situation, both from the north and the south. Such transitions should be less frequent and abrupt, if not eliminated entirely. Another strategy is to separate the higher-speed through traffic from local traffic accessing adjacent land uses.

- Weaving-related collisions are also a significant problem on US 70/US 401 between Mechanical Boulevard and Tryon Road (especially northbound). Options for reducing the number of these crashes include physically lengthening the weaving section, lowering speeds, or reducing the volume of weaving traffic (by restricting turns or re-routing trips).

- Frequent driveway conflicts lead to rear-end and right-angle collisions. Access management in the form of driveway consolidation and restrictions to left-turning and crossing traffic can reduce the frequency of such crashes, as well as increasing capacity.

Access Management

For the most part, access management along US 70/US 401 in the study area is not a major problem. Access conflicts are most prevalent along US 401 south of Mechanical Boulevard, due to frequent driveways and intersections, compounded by the presence of a two-way left-turn lane (TWLTL). The US 401 superstreet project in the current STIP (Project No. U-5302) is intended to address this issue just south of the study area. Due to the presence of a median, access management is more successful along the corresponding segment of US 70.

The eastern portion of Tryon Road has a TWLTL, and while it carries less traffic than US 401 and has fewer conflict points, it will experience increasing access-related problems as traffic volumes increase.

Frequent driveways and intersections are also obstacles to safe, convenient, and comfortable bicycle and pedestrian travel. Any recommendations should incorporate access management in their design.

Traffic Growth

Increasing traffic volumes are a key challenge to maintaining safe, efficient accessibility and mobility in this corridor. Reliable estimates of anticipated traffic growth are essential to developing appropriate mitigations and improvements. Future-year traffic volumes on the study area network were estimated for the year 2045 using outputs from the Triangle Regional Travel Demand Model (TRM v6). The model network reflects projects in the adopted CAMPO Metropolitan Transportation Plan (MTP), as described

previously (refer to Table 1). The traffic volumes assigned by TRM to each link in the 2045 network were not used directly as forecast volumes. Instead, in accordance with preferred practice, the increment of traffic growth between the 2018 and 2045 model runs was applied to the factored and balanced traffic count data used for the Existing Conditions analysis. These volume estimates were then smoothed and balanced before factoring to peak-period design volumes and turning movements.

Table 9 summarizes traffic forecast results for 2045. Figure 10 depicts the resulting AM and PM peak-hour turning movements used to analyze traffic conditions at the selected study area intersections. These forecasts suggest that traffic will grow at an annual rate of about 2% annually for the next 25-30 years.

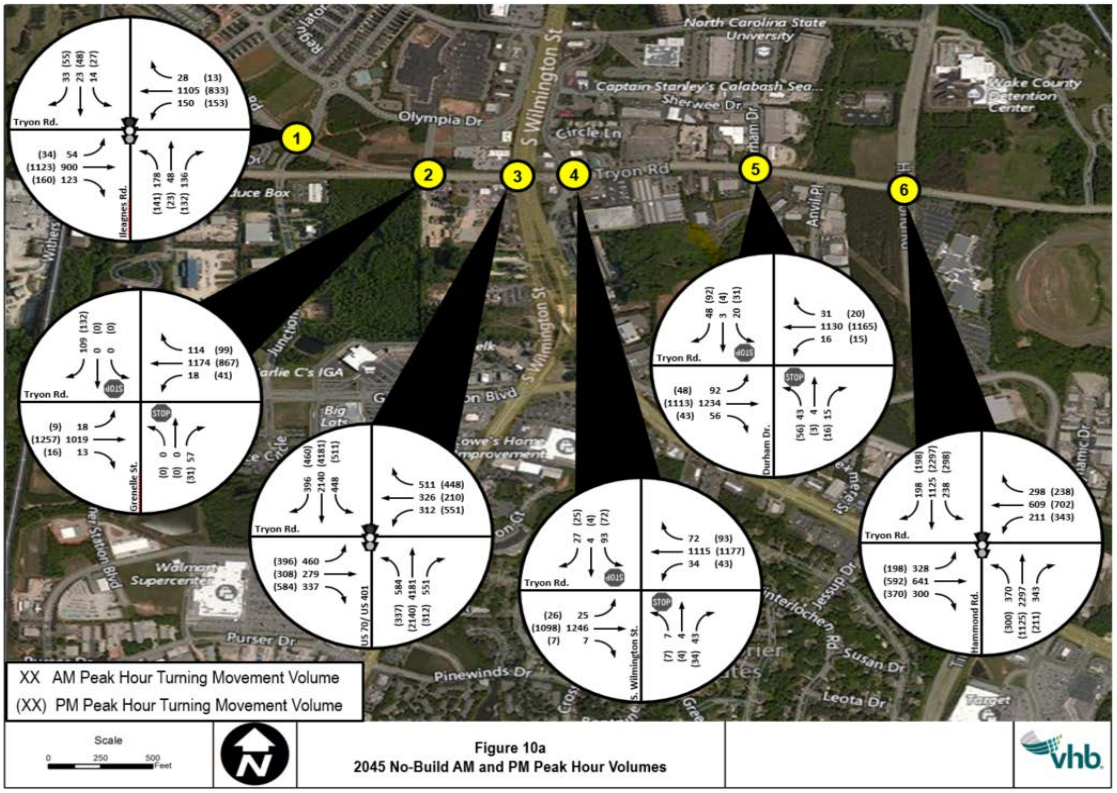
Table 9. 2045 Traffic Forecast Summary.

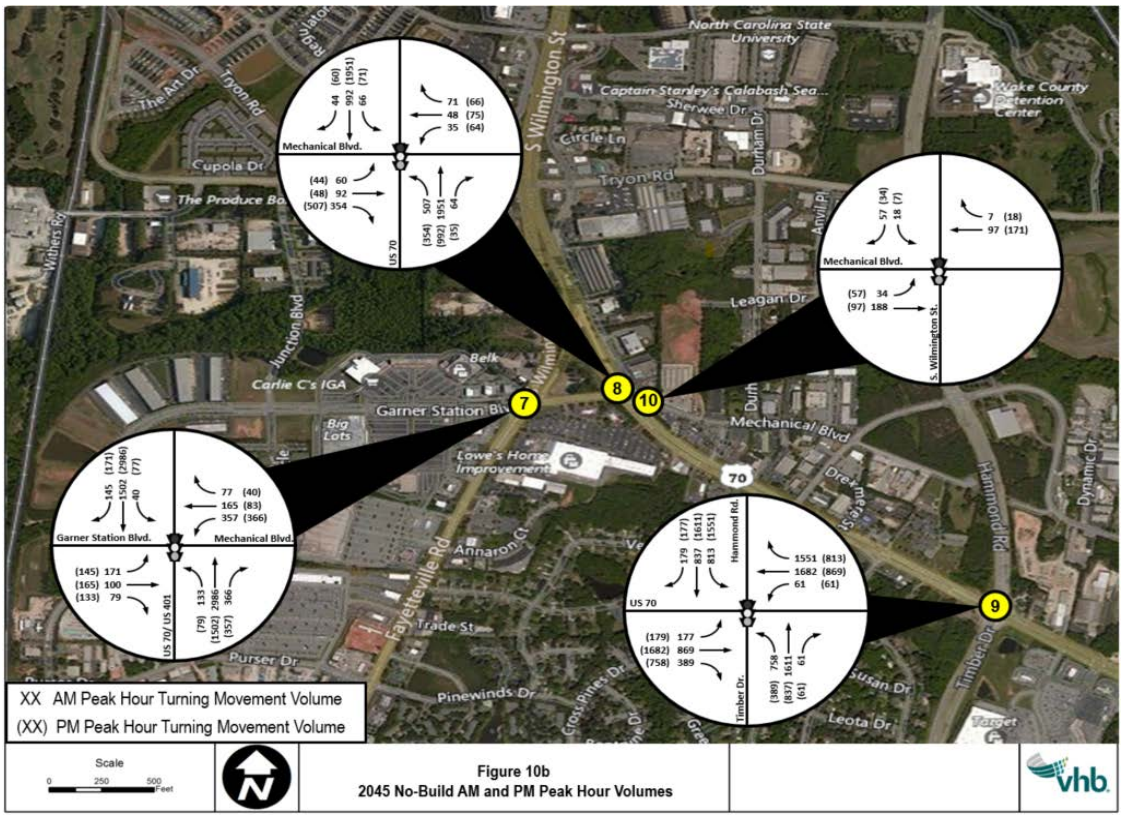
Label	ID	Road Name			2018 Base Year		2045 No-Build Model Volume	2045 No-Build AADT Forecast Volume*
		Intersection Location	Route	Selected Segment	No-Build Model Volume	No-Build Forecast Volume		
N	101	SR 1370 (Tryon Road) at Ileagnes Road	Ileagnes Road	North of SR 1370 (Tryon Road)		1,700		2,000
E			SR 1370 (Tryon Road)	East of Ileagnes Road	14,711	15,100	25,485	26,000
S			Ileagnes Road	South of SR 1370 (Tryon Road)		6,900		7,400
W			SR 1370 (Tryon Road)	West of Ileagnes Road	14,711	15,700	25,794	26,800
N	201	SR 1370 (Tryon Road) at Grenelle Street	Grenelle Street	North of SR 1370 (Tryon Road)		2,100		2,500
E			SR 1370 (Tryon Road)	East of Grenelle Street	14,711	15,400	25,485	26,200
S			Grenelle Street	South of SR 1370 (Tryon Road)		800		1,100
W			SR 1370 (Tryon Road)	West of Grenelle Street	14,711	15,100	25,485	26,000
N	301	US 70/US 401 (S Wilmington Street) at SR 1370/2684 (Tryon Road)	US 70/US 401 (Wilmington Street)	North of SR 2684 (Tryon Road)	59,846	60,700	101,907	102,800
E			SR 2684 (Tryon Road)	East of US 70/US 401 (Wilmington Street)	7,499	12,100	22,004	26,700
S			US 70/US 401 (Wilmington Street)	South of SR 2684 (Tryon Road)	52,660	70,000	83,571	100,900
W			SR 1370 (Tryon Road)	West of US 70/US 401 (Wilmington Street)	14,711	15,400	25,485	26,200

Label	ID	Road Name			2018 Base Year		2045 No-Build Model Volume	2045 No-Build AADT Forecast Volume*
		Intersection Location	Route	Selected Segment	No-Build Model Volume	No-Build Forecast Volume		
N	**401**	**SR 2684 (Tryon Road) at S Wilmington Street**	S Wilmington Street	North of SR 2684 (Tryon Road)		2,900		3,200
E			SR 2684 (Tryon Road)	East of S Wilmington Street	7,499	11,400	22,004	25,900
S			S Wilmington Street	South of SR 2684 (Tryon Road)		1,200		1,400
W			SR 2684 (Tryon Road)	West of S Wilmington Street	7,499	12,100	22,004	26,700
N	**501**	**SR 2684 (Tryon Road) at Durham Drive**	Durham Drive	North of SR 2684 (Tryon Road)		1,400		2,200
E			SR 2684 (Tryon Road)	East of Durham Drive	5,146	11,400	18,638	27,000
S			Durham Drive	South of SR 2684 (Tryon Road)		800		1,700
W			SR 2684 (Tryon Road)	West of Durham Drive	5,146	11,400	18,638	25,900
N	**601**	**SR 2684 (Tryon Road) at SR 2026 (Hammond Road)**	SR 2026 (Hammond Road)	North of SR 2684 (Tryon Road)	19,650	24,500	35,878	40,700
E			SR 2684 (Tryon Road)	East of SR 2026 (Hammond Road)	4,458	11,800	18,409	25,800
S			SR 2026 (Hammond Road)	South of SR 2684 (Tryon Road)	22,019	22,900	41,635	42,300
W			SR 2684 (Tryon Road)	West of SR 2026 (Hammond Road)	7,277	11,400	18,638	27,000

Label	ID	Road Name			2018 Base Year		2045 No-Build Model Volume	2045 No-Build AADT Forecast Volume*
		Intersection Location	Route	Selected Segment	No-Build Model Volume	No-Build Forecast Volume		
N	**701**	**US 401 (Fayetteville Road) at SR 2538 (Mechanical Boulevard)**	US 401 (Fayetteville Road)	North of SR 2538 (Mechanical Boulevard)	31,481	41,900	70,328	61,200
E			SR 2538 (Mechanical Boulevard)	East of US 401 (Fayetteville Road)	9,672	11,400	13,818	15,800
S			US 401 (Fayetteville Road)	South of SR 2538 (Mechanical Boulevard)	41,153	46,100	84,146	68,100
W			Garner Station Boulevard	West of US 401 (Fayetteville Road)		8,600		9,900
N	**801**	**US 70 at SR 2538 (Mechanical Boulevard)**	US 70/US 401 (Wilmington Street)	North of SR 2538 (Mechanical Boulevard)	21,179	28,100	33,243	39,700
E			SR 2538 (Mechanical Boulevard)	East of US 70/US 401 (Wilmington Street)	2,748	2,400	4,237	4,200
S			US 70/US 401 (Wilmington Street)	South of SR 2538 (Mechanical Boulevard)	29,490	35,500	42,879	48,900
W			SR 2538 (Mechanical Boulevard)	West of US 70/US 401 (Wilmington Street)	9,672	11,400	13,818	15,800
N	**901**	**US 70 at SR 2026 (Hammond Road)/ SR 2812 (Timber Drive)**	SR 2026 (Hammond Road)	North of US 70	20,225	20,300	46,995	47,100
E			US 70	East of SR 2026 (Hammond Road)	27,323	38,600	51,401	62,800
S			SR 2812 (Timber Drive)	South of US 70	28,354	20,800	41,245	33,700
W			US 70	West of SR 2026 (Hammond Road)	27,539	37,300	41,100	50,800
N	**1001**	**SR 2538 (Mechanical Boulevard) at S Wilmington Street**	S Wilmington Street	North of SR 2538 (Mechanical Boulevard)		800		1,300
E			SR 2538 (Mechanical Boulevard)	East of S Wilmington Street	2,748	2,200	4,237	3,900
S								
W			SR 2538 (Mechanical Boulevard)	West of S Wilmington Street	2,748	2,400	4,237	4,200

Figure 10. 2045 No-Build AM and PM Peak Hour Volumes.

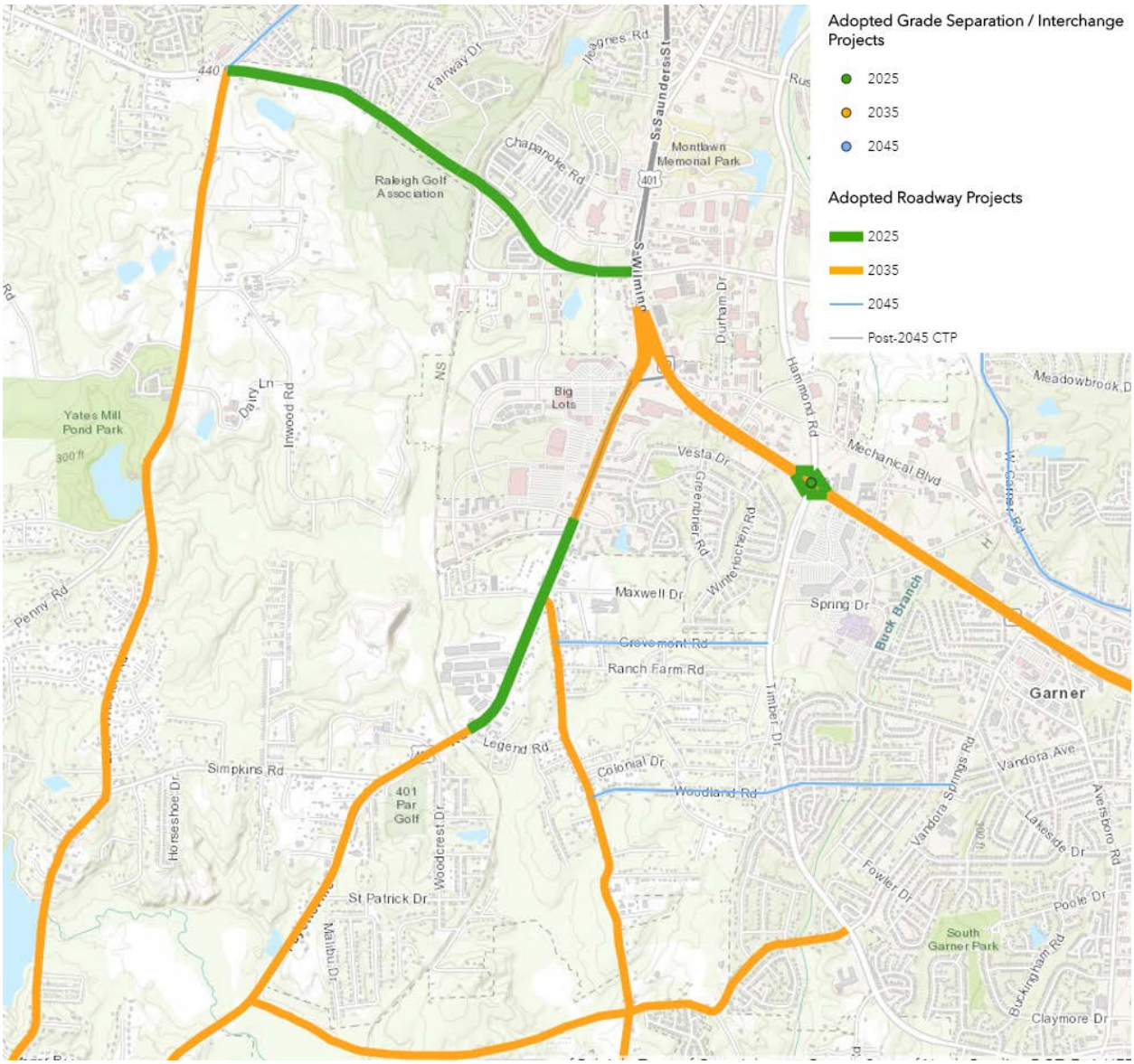




Planned Transportation Improvements

The traffic volumes described above and used to analyze 2045 conditions depend on timely implementation of relevant transportation improvement projects in the adopted CAMPO MTP and STIP. Figure 11 shows committed and planned projects in the study area that will significantly affect the magnitude and distribution of traffic traveling within and through the study area. Substantial changes to the scope, design, or implementation schedule of these transportation projects could considerably alter traffic forecasts. Similarly, major technological or economic changes are not considered due to unpredictability, and the unlikelihood that any such changes would have dramatic impacts within the analysis timeframe.

Figure 11. Adopted Transportation Projects.



Level of Service

Table 10 compares existing peak-hour intersection LOS in 2018 with conditions in 2018 assuming the Short-Term Improvements described below are implemented. Given the limited scale of these recommendations, no dramatic improvements are immediately evident; however, relative LOS benefits will increase as traffic volumes grow. Furthermore, some of the recommendations have safety benefits as well.

Table 10. 2018 Intersection LOS.

ID	Intersection Name	Traffic Control	Base Year (2018) No-Build		Build (2018) Short-Term Improvements	
			AM	PM	AM	PM
101	Tryon Road & Ileagnes Road	Signalized	C (NB-E)	C (NB-C)	C (NB-E)	C (NB-C)
201	Tryon Road & Grenelle Street	Unsignalized	(SB-B)	(NB-B)	(SB-B)	(NB-B)
301	Tryon Road & US 70 / US 401	Signalized	C (WB-E)	D (WB-F)	D (WB-E)	D (WB-E)
401	Tryon Road & S Wilmington Service Rd	Unsignalized	(SB-D)	(SB-D)	(NB-B)	(SB-B)
501	Tryon Road & Durham Road	Unsig/Sig	(NB-D)	(NB-D)	B (SB-D)	B (SB-D)
601	Tryon Road & Hammond Road	Signalized	D (WB-E)	D (WB-E)	D (WB-E)	D (WB-E)
701	Garner Station Boulevard / Mechanical Boulevard & West C-D Road	Signalized	D (EB-E)	E (SB-F)	C (WB-E)	D (WB-E)
801	Mechanical Boulevard & US 70 On-Ramp	Signalized	B (WB-D)	C (WB-D)	D (SB-E)	D (EB-D)
901	US 70 & Timber Drive / Hammond Road*	Signalized	D (SB-E)	D (SB-E)	D (SB-E)	D (SB-E)
1001	Mechanical Boulevard & S Wilmington Service Rd	Unsignalized	(SB-A)	(SB-A)	(SB-A)	(SB-A)

Legend: X - Overall Level of Service, (XXX) - Worst Approach-Worst Approach Level of Service

** No Improvements*

It is also difficult to accurately assess the impacts of an improvement based on individual intersection performance. The tight interactions among the three critical US 70/US 401 intersections (at Tryon Road, Mechanical Boulevard, and Garner Station Boulevard) mean that improving conditions at one location can make things worse at another. For example, shifting eastbound left turns from Garner Station/US 401 to Mechanical/US 70 improves the PM LOS from E to D at Garner Station/US 401, but worsens Mechanical/US 70 from LOS C to D. This same change also causes the AM LOS at Tryon/US 70 to drop from C to D. The trade-off for eliminating a failing LOS of E is minor reductions in LOS (within acceptable ranges) at two other locations.

Table 11 presents similar results for analysis of conditions in 2045. The No-Build scenario analyses AM and PM traffic assuming no improvements beyond those in the adopted STIP and MTP. The Mechanical Boulevard Overpass scenarios evaluates conditions assuming all the recommendations described below are implemented, including three US 70/US 401 overpasses at the critical intersections described above. The final scenario assumes an overpass at Tryon Road only; Mechanical Boulevard and Garner Station Boulevard retain at-grade intersections, with modifications.

Table 11. 2045 Intersection LOS.

ID	Intersection Name	Traffic Control	Base Year (2018) No-Build		No-Build (2045)		Build (2045) Mechanical Blvd Overpass		Build (2045) Mechanical Blvd Limited	
			AM	PM	AM	PM	AM	PM	AM	PM
101	Tryon Road & Ileagnes Road	Signalized	C (NB-E)	C (NB-C)	C (NB-C)	B (NB-C)	C (NB-C)	C (NB-C)	C (NB-C)	C (NB-C)
201	Tryon Road & Grenelle Street	Unsignalized	(SB-B)	(NB-B)	(SB-C)	(NB-C)	(SB-C)	(SB-B)	(SB-C)	(SB-C)
202	Tryon Road & Grenelle Street	Signalized	(-)	(-)	(-)	(-)	B (NB-D)	B (SB-C)	A (NB-C)	A (SB-C)
204	Grenelle Street & EB Ramp	Unsignalized	(-)	(-)	(-)	(-)	(EB-B)	(EB-B)	(EB-A)	(EB-A)
301	Tryon Road & US 70 / US 401	Signalized	C (WB-E)	D (WB-F)	F (WB-F)	F (WB-F)	B (SB-C)	D (SB-D)	B (SB-C)	D (SB-D)
302	Tryon Road & East C-D Road	Signalized	(-)	(-)	(-)	(-)	D (WB-D)	C (WB-C)	D (WB-D)	C (WB-C)
401	Tryon Road & S Wilmington Service Rd	Unsignalized	(SB-D)	(SB-D)	(SB-F)	(SB-F)	(NB-C)	(SB-C)	(NB-C)	(SB-C)
501	Tryon Road & Durham Road	Unsig/Sig	(NB-D)	(NB-D)	(NB-F)	(NB-F)	A (SB-D)	A (SB-C)	A (SB-C)	A (SB-C)
601	Tryon Road & Hammond Road	Signalized	D (WB-E)	D (WB-E)	F (WB-F)	F (EB-F)	D (EB-E)	C (WB-E)	D (EB-E)	C (WB-E)
701	Garner Station Boulevard / Mechanical Boulevard & West C-D Road	Signalized	D (EB-E)	E (SB-F)	F (NB-F)	F (SB-F)	C (EB-C)	C (WB-D)	A (EB-D)	C (EB-D)
702	Mechanical Boulevard & US 401 Off-Ramp	Signalized	(-)	(-)	(-)	(-)	B (NB-C)	B (NB-C)	(-)	(-)
801	Mechanical Boulevard & US 70 On-Ramp	Signalized	B (WB-D)	C (WB-D)	C (WB-F)	D (WB-F)	A (EB-A)	A (EB-A)	C (EB-C)	C (EB-E)
802	Mechanical Boulevard & East C-D Road	Signalized	(-)	(-)	(-)	(-)	D (EB-D)	C (NB-C)	(-)	(-)
901	US 70 & Timber Drive / Hammond Road*	Signalized	D (SB-E)	D (SB-E)	F (WB-F)	F (SB-F)	F (WB-F)	F (WB-F)	F (WB-F)	F (SB-F)
1001	Mechanical Boulevard & S Wilmington Service Rd	Unsignalized	(SB-A)	(SB-A)	(SB-A)	(SB-B)	(-)	(-)	(-)	(-)

Legend: X - Overall Level of Service, (XX-X) - Worst Approach-Worst Approach Level of Service

** No Improvements*

The most striking observations is that under the No-Build scenario, six of the ten intersections analyzed deteriorate to LOS F in both the AM and PM peaks. These include the four most critical signalized intersections.

Each of the Build scenarios provides an LOS D or better for each intersection. While the At-Grade alternative is less expensive, it does reduce convenience and accessibility to adjacent land uses, and could increase vehicle-mails travelled.

Note that the US 70/Timber Drive intersection was not fully analyzed in this study, since there is already a project to convert this at-grade intersection to an interchange.

Short-Term Improvements

Several projects that can be implemented in the near-term and which provide incremental benefits are described below. Figure 12 identifies the locations of these projects; Figure 13 indicates proposed intersection lane and traffic control modifications.

Figure 12. Recommended Short-Term Improvements.

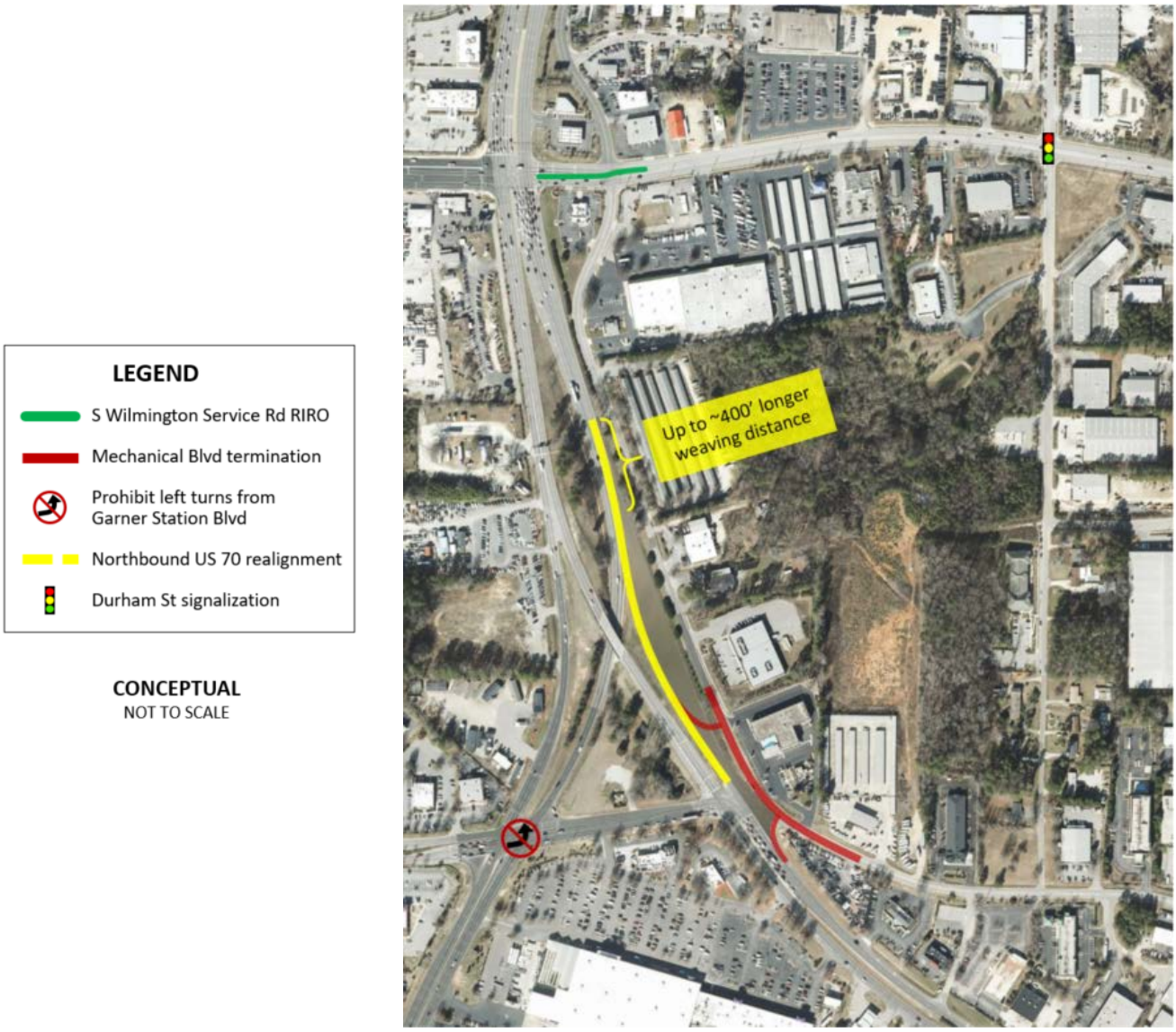
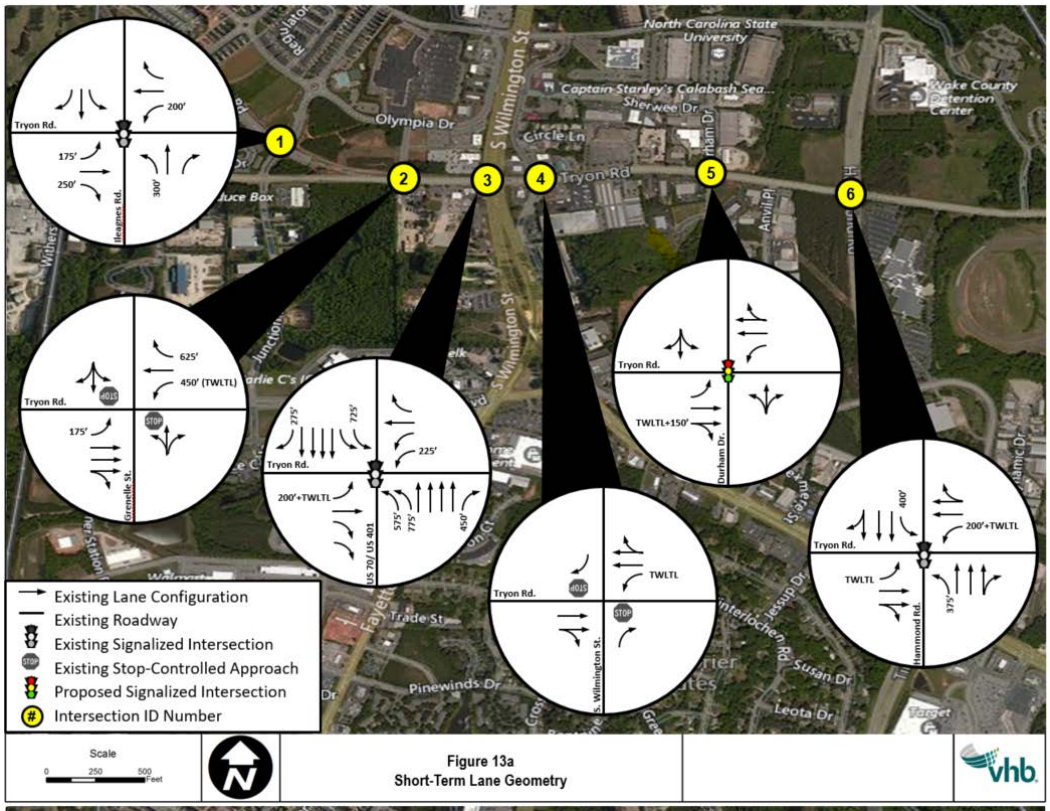
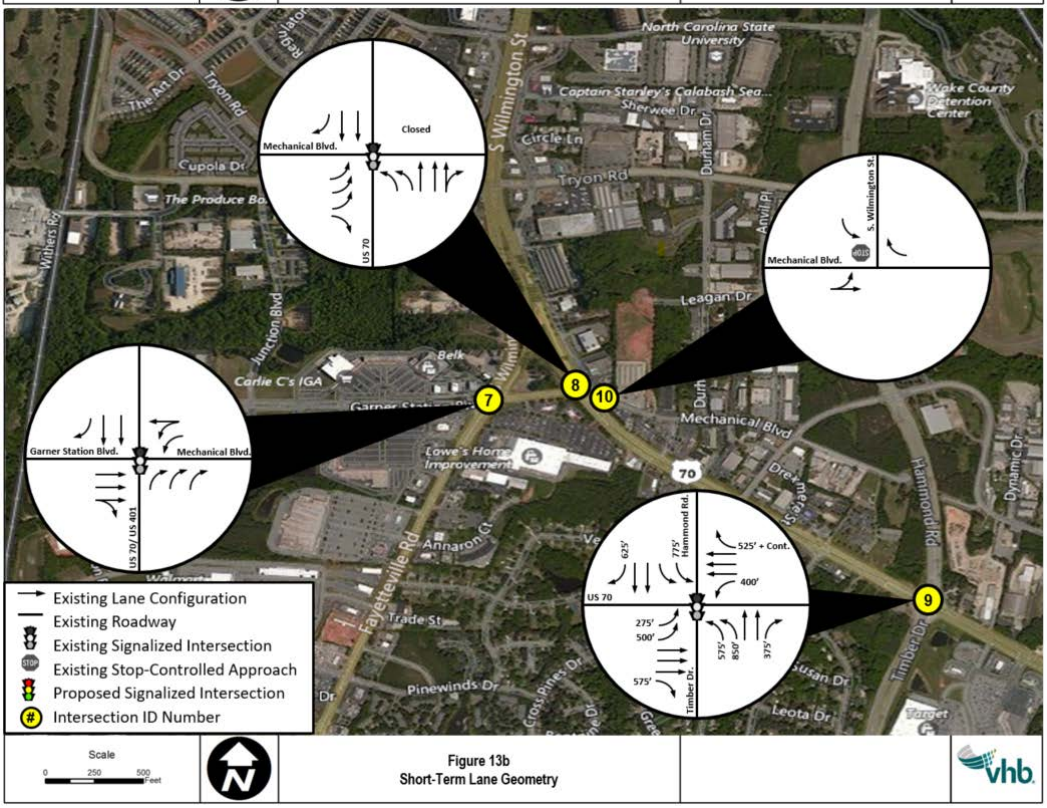


Figure 13. Recommended Short-Term Lane Geometries.





Tryon Road & South Wilmington Service Road Intersection

To reduce conflicts and delay, convert the current STOP-controlled intersection of South Wilmington Service Road at Tryon Road to right-in/right-out (RIRO) turns only. Given that vehicle queues often extend beyond the less than 250-foot distance from the US 70/US 401 intersection, this will improve both safety and operations. No changes to lane configurations are required, only signage and lane markings. Extending the existing concrete median and installing "pork chop" islands are both recommended. The recommended signalization of Durham Street (see below) will help accommodate these turn restrictions.

Tryon Road & Durham Street Intersection Signalization

The recommended signalization of Durham Street is based primarily on safety, although the anticipated growth in traffic volumes will increase delays, as well. The proposed access restrictions at South Wilmington Street also contribute to the desirability of signalizing Durham Street, since U-turning traffic will increase. This signal will also create a safer and more reliable pedestrian crossing along a 3,000' segment of Tryon Road that currently lacks such opportunities.

Garner Station/Mechanical Boulevard Intersection Modifications

While the intersection of Mechanical Boulevard and US 70 operates at acceptable levels of service during peak hours (AM LOS = B; PM LOS = C), the intersection of Garner Station Boulevard at US 401 experiences considerable congestion (AM LOS = D; PM LOS = E), due mainly to heavy left-turn volumes from Garner Station Boulevard onto northbound US 401.

Shifting these left turns to the Mechanical Boulevard/US 70 intersection was evaluated as an option to improve overall level of service at both locations, as well as reducing weaving problems at the US 70 and US 401 merge immediately to the north. This solution does have the potential to improve conditions at the Garner Station Boulevard/US 401 intersection (AM LOS = C; PM LOS = D), while maintaining acceptable conditions at Mechanical Boulevard/US 70 (AM LOS = D; PM LOS = D).

However, this alternative must eliminate through movements and left turns to/from the eastern leg of Mechanical Boulevard at US 70. Right turns to/from US 70 could still be accommodated via slip ramps north and south of the existing intersection. Other turning movements could be accommodated via McCormick Street.

US 70 Ramp North of Mechanical Boulevard

To address the congestion and high rates of sideswipe and other weaving-related crashes on the northbound segment of US 70 between Mechanical Boulevard and Tryon Road, a recommendation was developed to lengthen the available weaving area. This can be accomplished by shifting the ramp westward to merge with the northbound US 401 lanes at a point approximately 400' south of the current gore area. Realignment can be accomplished within available right-of-way, and should not entail excessive grading or drainage work.

Long-Range Recommendations

A comprehensive set of integrated projects is described below. These integrated solutions were developed to address long-term traffic growth, future development pressures, and access needs. Figure 14 maps an overview of these long-range recommendations. Figure 15 focuses more on the US 70/US 401 corridor. Figure 16 summarizes the intersection geometry and traffic control at each of the analyzed intersections.

Figure 14. Long-Range Recommendations.

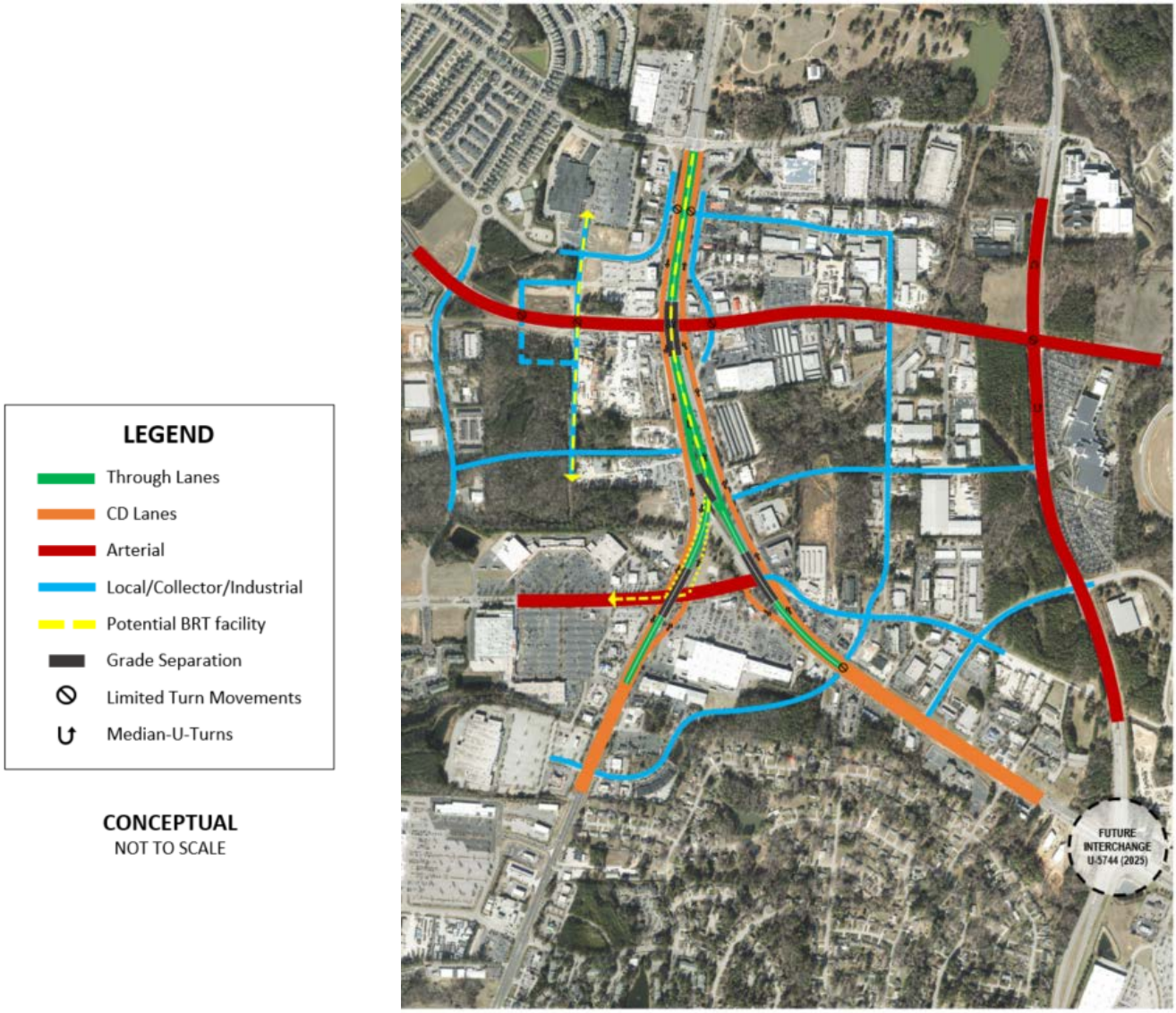


Figure 15. Mechanical Blvd Maintained, with Overpass.

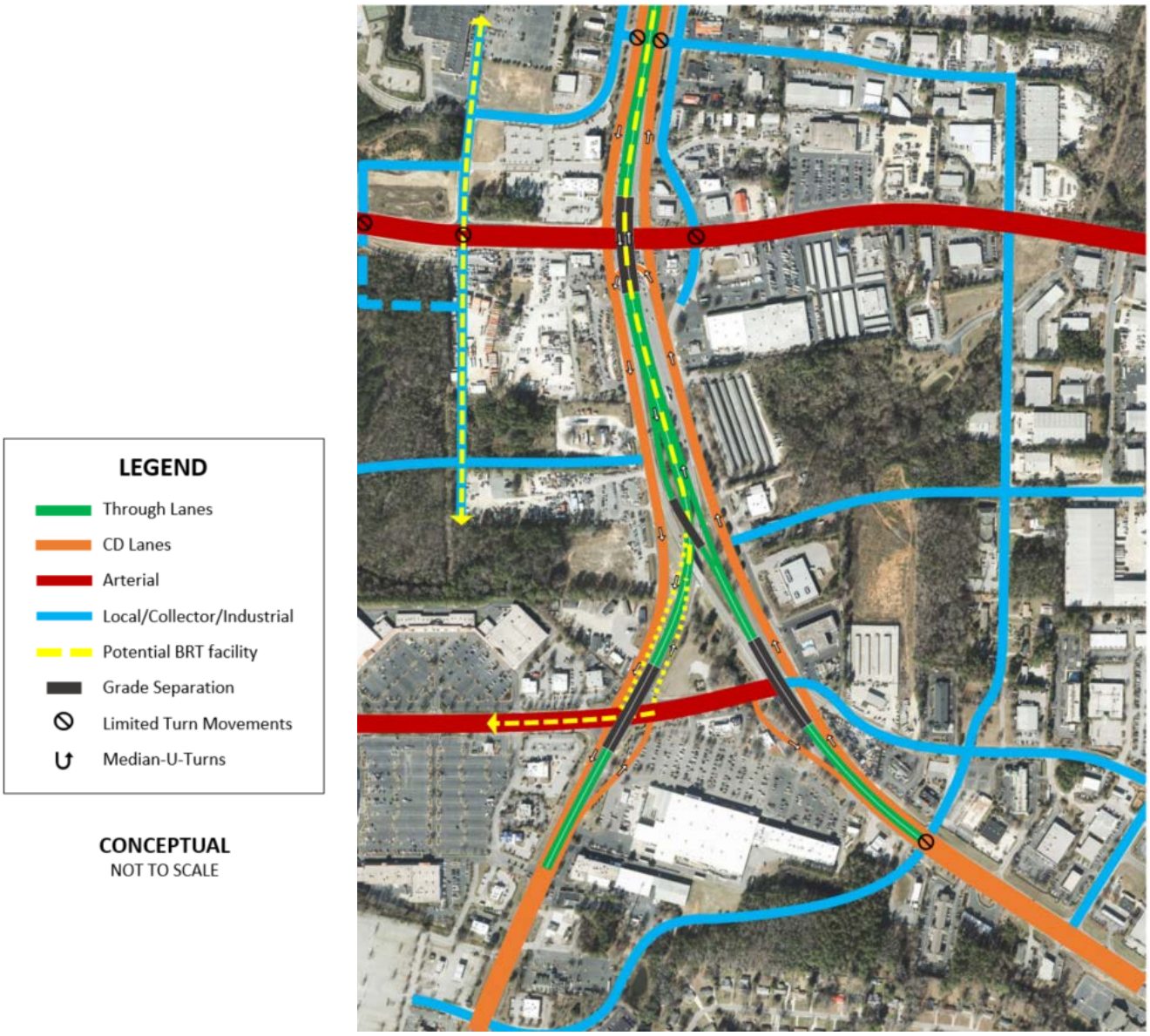
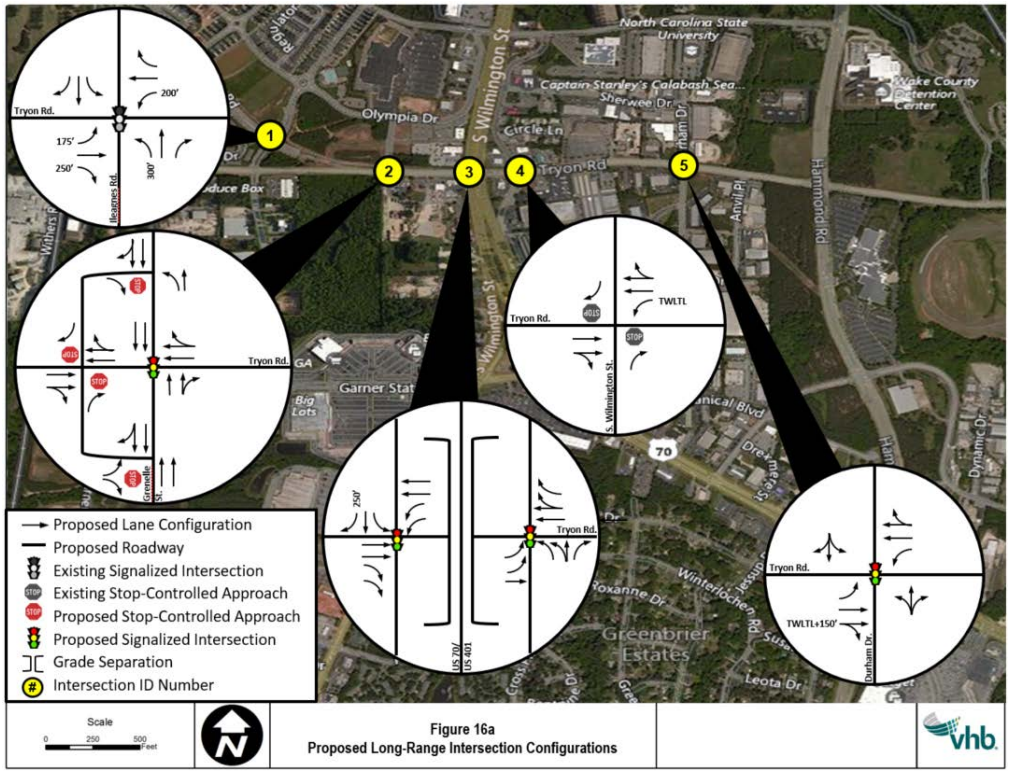
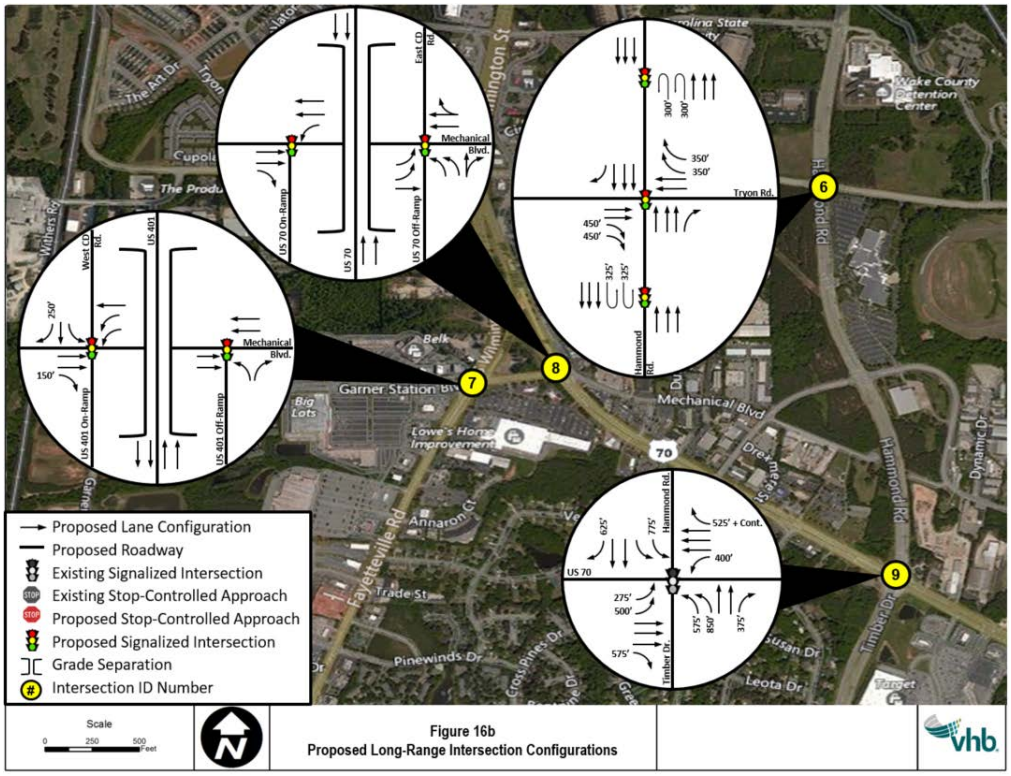


Figure 16. Recommended Long-Range Intersection Guidelines.





US 70/US 401

The main objectives of this study focus on improving the ability of US 70 and US 401 to carry traffic safely and efficiently through the corridor segment including Tryon Road and Garner Station/Mechanical Boulevard.

Given the dramatic increase in forecast traffic volumes on both Tryon Road and US 70/US 401, an at-grade intersection cannot continue to provide acceptable functionality; some vertical separation of movements will be needed to reduce conflicts and delays. However, an interchange with a large footprint would displace considerable existing development, as well as preclude future land uses consistent with desired goals of urban density, walkability, and transit-compatibility. The preferred solution should meet the following objectives:

- Minimize footprint, preferably staying within existing rights-of-way
- Balance traffic throughput against access to adjacent development
- Provide adequate long-term capacity
- Be implemented without excessive disruption to transportation or land use
- Reduce crash potential
- Minimize cost

A similar situation occurs at the Mechanical Boulevard and Garner Station Boulevard intersections. Although the splitting of US 70 and US 401 between these two intersections reduces volumes relative to Tryon Road, their close spacing creates substantial weaving and queuing problems; access and land use challenges are even greater.

A range of options were evaluated and refined, ultimately resulting in a complex compressed-diamond interchange variant. The recommended alternative uses central "express" lanes (two southbound, three northbound) to serve traffic traveling through the study area via US 70 or US 401. These lanes start just south of Chapanoke Road, then begin rising on a retaining wall structure before crossing above Tryon Road. An alignment similar to the existing flyover configuration (but tighter) is followed, with three lanes in each direction north of the US 70/US 401 split. South of the split and flyover, the two northbound and two southbound lanes of each facility converge and begin gaining elevation to pass over Garner Station/Mechanical Boulevards. Retaining walls are again employed as these lanes descend in the centers of US 70 and US 401, eventually re-merging with the at-grade local traffic lanes of each facility.

Parallel one-way collector-distributer (CD) roads provide local access for north-south traffic along this segment of US 70 and US 401. Beginning just south of Chapanoke Drive, two lanes in each direction flank the central "express" or though lanes, with the southbound (West CD Road) widening to three lanes north of Tryon Road. South of the paired at-grade intersections with Tryon Road, the West CD Road narrows back to two lanes, while the northbound East CD Road requires three lanes at the intersection approach, before transitioning back to two lanes.

The western leg of Tryon Road consists of two through and two right-turn approach lanes, and two departing lanes at its intersection with West CD Road. The eastern leg requires three approach lanes and two departure lanes. Between the two CD Road intersections, westbound Tryon Road includes two through lanes and two left-turn lanes; eastbound, one through and two left-turn.

A "Texas U-turn" connects the East CD and West CD Roads immediately south of Tryon Road, beneath the US 70/US 401 overpass. This link allows local traffic to bypass major signalized intersections, facilitating access and circulation, and reducing congestion in the mainline intersections.

At the Garner Station Boulevard signalized intersection, the southbound West CD Road approach widens to three lanes; two lanes are carried through the intersection, eventually re-merging with the grade-separated US 401 through traffic approximately 900' south of Garner Station Boulevard. Also at this location, two northbound lanes of US 401 diverge from the through lanes, creating an "off-ramp" accessing Mechanical Boulevard a signalized "T" intersection. To the south, US 401 consists of four southbound and three northbound lanes before transitioning to its typical section.

This configuration is a near mirror-image of the Mechanical Boulevard intersection with the northbound East CD Road. The main difference is that the southbound US 70 "on-ramp" originating at a signalized "T" intersection on Mechanical Boulevard requires only a single lane instead of two. Immediately south of the re-merging of the through and local lanes, US 70 requires three lanes in each direction.

Alternate Configuration

To reduce construction costs, an alternative was developed that does not require grade-separations at the Garner Station and Mechanical Boulevard intersections, as depicted in Figure 17. This option could serve as the ultimate design, or could be implemented as an intermediate phase. For this option to be viable, however, the following conditions must be met:

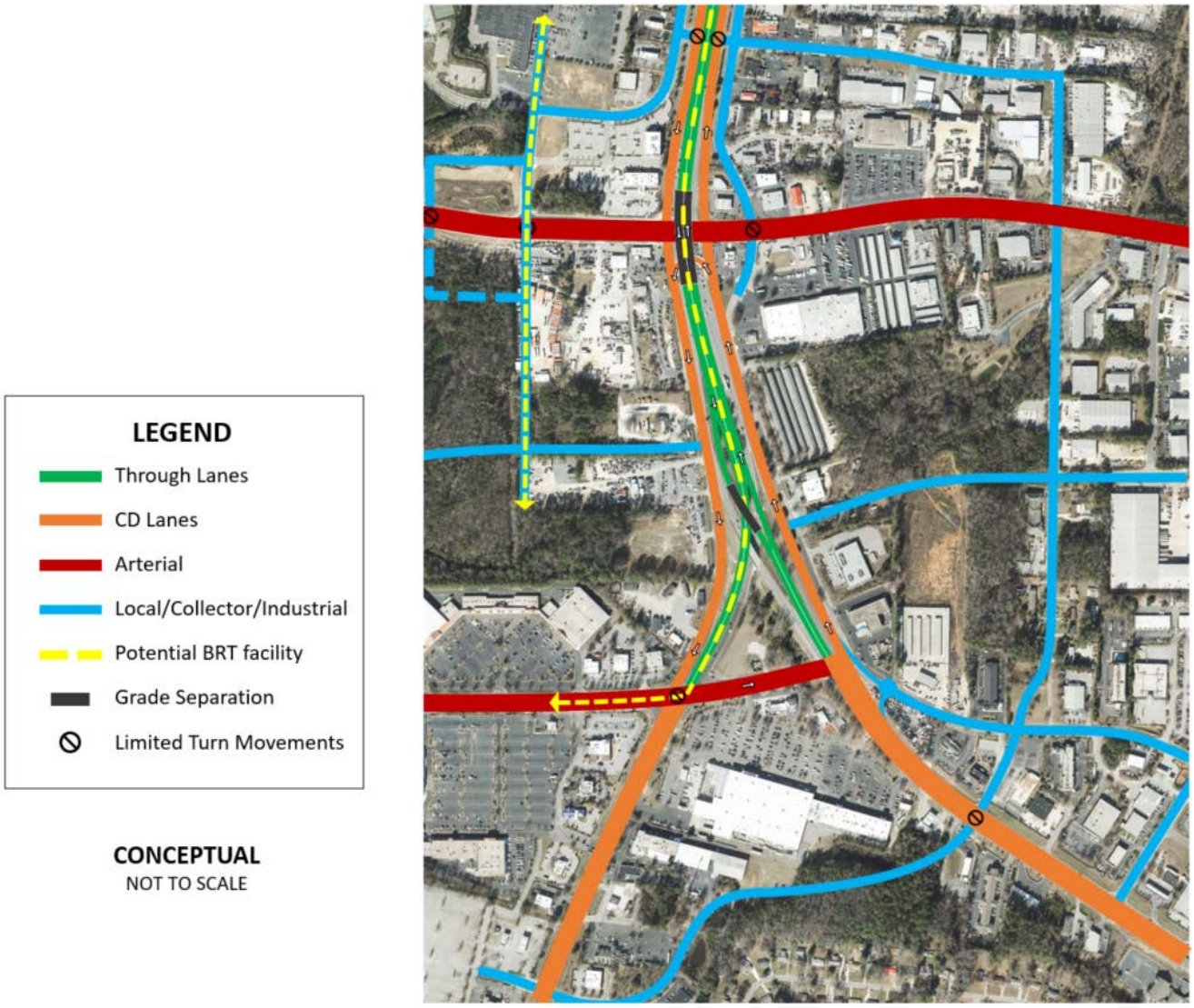
- Through-movements along Mechanical Boulevard must be terminated at US 70; only right turns could be permitted between the eastern leg of Mechanical Boulevard and US 70/East CD Road. All other movements would be accommodated either at McCormick Street or the proposed extension of Durham Drive.
- Mechanical Boulevard becomes one-way eastbound between US 401 and US 70.
- Northbound left turns from Garner Station Boulevard are prohibited, and can occur only at US 70 and Mechanical Boulevard.

In this scenario, the southern termini of the US 70/US 401 through lanes are at signalized, at-grade intersections with Mechanical Boulevard and Garner Station Boulevard, respectively. There is no need for southbound "off-ramps" (US 401) or northbound "on ramps" (US 70). Other characteristics of this alternative:

- Mechanical Boulevard would consist of three eastbound lanes between US 401 and US 70.
- The US 401 approach north of Garner Station Boulevard requires four southbound and two northbound lanes; the southern approach, three southbound and four northbound.
- The Garner Station Boulevard leg west of US 401 requires two lanes in each direction; however, this approach forces eastbound traffic to turn right. Through movements and left turns are accomplished via a median U-turn, or by using alternate routes to access US 401 farther south.
- The US 70 approach north of Mechanical Boulevard requires two southbound and three northbound lanes; the southern approach, three southbound and three northbound.

The turning restrictions proposed at Garner Station Boulevard and US 70 are needed to reduce conflicts to a level where a reasonably-sized at-grade intersection can accommodate heavy US 401 through movements without excessive delay. It would be possible to implement a hybrid version of the two alternatives (possibly as an interim phase), in which US 401 is grade-separated from Garner Station Boulevard while US 70 remains at-grade.

Figure 17. Intermediate Alternative: Mechanical Blvd Terminated, without Overpasses.



Tryon Road

The recent widening and realignment of Tryon Road in the western portion of the study area reflects ongoing residential and traffic growth along this facility, compounded by its proposed extension eastward to Sunnybrook Road. The Raleigh Street Plan classifies Tryon Road as a Divided 6-Lane Avenue west of US 70/US 401, and Divided 4-Lane Avenue to the east. Ultimately, access management (and some additional laneage) will be needed to maintain acceptable levels of service and safety throughout this corridor. It is anticipated that the current two-way left-turn lane (TWLTL) will eventually be replaced by a median or barrier, and that some superstreet elements may be implemented. Additionally, sidewalk connectivity and pedestrian crossings should be enhanced, both to encourage walkability and to support future transit service. Raleigh's Divided Avenue street cross-sections call for bike lanes; this would require a significant long-term investment.

Specific long-range intersection recommendations are described below.

- Ileagnes Road/Junction Boulevard & Tryon Road

  No improvements are needed.

- Grennelle Street & Tryon Road

  The nature of improvements at this location depends greatly on several unknowns, the most important of which is whether South Wilmington Street is extended across US 70/US 401 as suggested in the Southern Gateway Corridor Study. Implementing this recommendation would dramatically increase traffic on an extended Grennelle Street, especially with the redevelopment expected to accompany such an investment. It is also uncleared how far southward the extension of Grennelle Street would ultimately extend. While it could eventually tie into Garner Station Boulevard, it could start out as a dead-end, or be connected with Junction Boulevard to the west. Another variable is the proposed implementation of bus rapid transit (BRT) in this corridor. The Raleigh Street Plan classifies this portion of Grennelle Street as a future Divided 4-Lane Avenue; with widening and additional modification, this cross-section could accommodate BRT in its median.

  In any case, increasing traffic volumes and proximity to US 70/US 401(less than 800') constrain the efficient movement of Grennelle Street traffic across Tryon Road. The most promising option appears to be implementing a quadrant intersection, in which left turns are accommodated via STOP-controlled roads in the northwest and southwest quadrants of the intersection. Through movements and right turns would use a two-phase signal at Grennelle Street; this signal would also serve pedestrian and bicycle crossings.

  Quadrant road intersections should be spaced approximately 500' from the main intersection. Within each quadrant, this can yield a viable building site of about 5 acres, with access via the quadrant road or right-in/right-out driveways on the main roads. Quadrant roads can be readily incorporated into a local street grid. A single-quadrant option could also be implemented, although signals may be required in place of STOP controls. Although unlikely, it would be possible grade-separate Grennelle Street to reduce delay and facilitate through traffic, should volumes warrant. However, the introduction of BRT service along Grennelle Street could make this option much more compelling.

- South Wilmington Service Road & Tryon Road

  Among the recommended short-term improvements is conversion of the current STOP-controlled intersection of South Wilmington Service Road to a right-in/right-out (RIRO) turns only. Construction of the compressed-diamond interchange hybrid requires the termination of South Wilmington Service Road just a few hundred feet south of Tryon Road, further reducing traffic volumes at this intersection.

- Durham Drive & Tryon Road

  As described in the recommended short-term improvements, signalization of the existing intersection is anticipated. Implementation of a superstreet treatment is also a possibility; however, this would be less favorable for bicycle and pedestrian crossings.

- Hammond Road & Tryon Road

  Traffic volumes on Hammond Road/Timber Drive will increase significantly over time, due not only to growth in this corridor, but also to a traffic shift in response to increasing congestion on US 70/US 401. The planned interchange at US 70 and Timber Drive (STIP Project No. U-5744) should generate a substantial traffic increase, as this becomes a more attractive route for downtown trips to/from the southeast. The resulting high volume of through traffic along Hammond Road combines with similar growth on Tryon Road (especially with its proposed eastward extension to Sunnybrook Road) to create severe congestion for the current intersection configuration.

  The most practical solution appears to be conversion to a median U-turn intersection, with left turns accommodated via signalized two-lane U-turns on Hammond Road. Two dedicated right-turn lanes would be required on each Tryon Road approach, but no other substantial widening should be necessary.

Garner Station Boulevard/Mechanical Boulevard

The grade-separated alternative described above triggers changes to both Garner Station and Mechanical Boulevards. Starting at the US 401 intersection, the western leg of Garner Station Road requires only two through lanes and a right-turn lane, and a single departure lane would be adequate (although two would be retained). The eastern approach includes a single through lane and dual lefts, with two departure lanes.

Except for a westbound left-turn lane at the US 70 "on ramp," two westbound and three eastbound lanes are adequate west of the East CD Road. Immediately east of this intersection, Mechanical Boulevard requires two westbound and one eastbound lane before transitioning back to its typical section.

Alternate Configuration

For the at-grade version of these junctions, very different lane configurations and cross-sections are needed. The Garner Station Boulevard leg west of US 401 requires two lanes in each direction. The eastbound lanes are both right-turn only; traffic wanting to go straight or turn left must use a median U-turn farther south on US 401. The opposite leg of this intersection consists of three eastbound lanes only, extending US 70, where this one-way segment of Mechanical Boulevard would terminate.

The only direct connections between US 70 and the portion of Mechanical Boulevard to the east are via right-turn-only slip ramps north and south of the intersection. Other turning movements could be accommodated via McCormick Street, or the proposed extension of Durham Drive.

Durham Drive

The Raleigh Street Plan classifies Durham Drive, Sherwee Drive, the eastern portion of Mechanical Boulevard, and South Wilmington Service Road as Industrial Streets. Together, these roads form a loop that provides primary access to almost all development between US 70 and Hammond Road. Over time, Durham Drive should play an increasingly important role in terms of access and connectivity, especially with signalization at Tryon Road, cross-section improvements south of Leagan Drive, possible extensions of Leagan Drive, and potential realignment and extension of Durham Drive southward to US 70. This intersection should be opposite the intersection of the proposed Annaron Court extension, and would likewise be a "left-over" or RIRO intersection. Durham Drive could serve local transit routes, and could be reclassified or modified to create a more attractive north-south bicycle and pedestrian route.

Annaron Court

The eastward extension of Annaron Court to US 70 provides a traffic circulation alternative that enhances access to retail development to the north, and helps relieve dependence on Mechanical Boulevard. It improves east-west connectivity, and offsets some of the impacts of turning movement restrictions resulting from access management and some recommendations for major intersections. The intersection with US 70 (potentially aligned with the proposed extension of Durham Drive) would not allow outbound left turns; the same may ultimately be the case at US 401, as well. The extension of Annaron Court would also provide a comparatively safe and convenient new option for east-west bicycle and pedestrian trips, and could add flexibility and convenience to the routing of local buses.

South Wilmington Service Road

Construction of the compressed-diamond interchange hybrid essentially replaces most of the South Wilmington Service Road south of Tryon Road with a northbound-only collector-distributer road (East CD Road). As a result, the existing service road would be stubbed out just a few hundred feet south of Tryon Road.

New Local/Access Streets

- *East of US 70/US 401* -- The extension of Leagan Drive west to the proposed East CD Road and east to Hammond Road would enhance access and connectivity for future development, increasing circulation options for all modes of travel.
- *West of US 70/US 401* -- The southward extension of Grennelle Street, along with anticipated development between Junction Boulevard and US 70/US 401, will eventually justify an east-west connection analogous to the proposed extension of Leagan Drive described above. This road would similarly improve access for all travel modes by connecting Junction Boulevard with the proposed southbound West CD Road at about the halfway point between Tryon Road and Garner Station Boulevard.

Access to Lowes Site

Access to the retail center anchored by Lowes is currently provided by five unsignalized driveways:

- A full-access driveway off Mechanical Boulevard midway between US 70 and US 401
- Two RIRO driveways off US 70
- One full-access and one RIRO driveway off US 401

Ease of access will deteriorate as traffic on surrounding roads increases. Some of the improvements identified as necessary to maintain acceptable traffic service levels will further affect this access, both positively and negatively. With some minor improvements to site circulation, the proposed extension of Annaron Court would enhance access options. While the through-lane flyover design further restricts already limited opportunities for left turns on/off US 70 and US 401, the trade-off is reduced delay at the Garner Station and Mechanical Boulevard intersections. The associated US 401 "off-ramp" and US 70 "on-ramp" can also be used for access to this site. The element that would probably affect site access most adversely is the one-way conversion of a key segment of Mechanical Boulevard as part of the alternate "no-overpass" configuration.

Pedestrian and Bicycle Accommodations

As currently developed, the study area is not conducive to pedestrian or bicycle travel. While there is residential development in Renaissance Park, Pinewinds, and Greenbriar, there are few significant attractors for walk and bike trips. Land uses are typically separated, with low-density, auto-oriented commercial and light-industrial development. Although there is significant transit usage, the sidewalk network is discontinuous, inconvenient, and uncomfortable, and signalized crosswalks are virtually nonexistent.

Tryon Road could ultimately be improved with continuous sidewalks, signalized crossings, and bicycle lanes or sidepaths. However, land use and urban design features would need to change to be more compatible and supportive of non-motorized trips.

US 70 and US 401 cannot be readily adapted to desirable bicycle facilities, due to heavy traffic volumes, high travel speeds, numerous trucks, and frequent conflicts in the southern portion of the corridor. Wide cross-sections plus incompatible land uses and development configurations further discourage both cyclists and pedestrians. In fact, these roads act more as barriers than as conduits for non-motorized trips.

A more productive strategy improves parallel north-south streets, such as Durham Drive and Grennelle Street. These lower-volume, lower-speed local roads can more readily (and inexpensively) be modified to serve compatibly-designed adjacent development, as well as providing connectivity for longer trips.

The proposed collector-distributor roads could also support sidewalks or multi-use paths along their "outer" frontages. These facilities could connect with sidewalks or sidepaths passing beneath the US 70/US 401 grade separations at either end (most likely on the southern side of each cross street). These grade separations can also facilitate pedestrian crossings of Tryon Road and Mechanical Boulevard/Garner Station Boulevard.

The proposed extension of Annaron Court provides an excellent opportunity to improve east-west connectivity for both pedestrians and cyclists. Although there are currently no sidewalks along US 70 or US 401, a reasonable case can be made for prioritizing such sidewalks south of Annaron Court, along the east side of US 401, and the west side of US 70. These locations would best serve nearby neighborhoods, and, with strategically-located, high-quality pedestrian crossing treatments, could enhance transit access.

Bus and Bus Rapid Transit (BRT) Service

The recommended improvements can potentially improve on-street bus service in several ways:

- Reducing congestion can minimize route delays, increasing reliability, efficiency, and user convenience. This benefit could be especially relevant to express service using US 70 or US 401.
- Increased connectivity resulting from improvements to Grennelle Street, Durham Drive, and Annaron Court provides opportunities to enhance local bus service, and to allow more convenient walk/bike access to stops on major routes.

Perhaps the most significant potential transit benefits, however, are associated with the bus rapid transit (BRT) system currently being planned for the Wilmington Street/South Saunders Street corridor. Although a final alignment has not been determined, the recommended improvements provide flexibility to accommodate either of the two leading alternatives under consideration. For the purposes of this study, the southern terminus of the BRT travelway is assumed to be at Garner Station.

The ultimate configuration of the proposed BRT system has not been finalized; it could run in the median or curbside, and could even employ each treatment at different locations. Intersection treatments are also undetermined. Similarly, while major development areas have been identified, specific station locations have not.

US 401

For the purposes of this study, this option assumes BRT follows US 401. It is possible that BRT could be routed along US 70 instead, or even combined with US 401 service. At this level of analysis, treatments and costs for either option are similar; combining both services would obviously be more complicated and expensive. The most significant modifications needed to adapt the recommended concept to accommodate this BRT alternative are:

- Adding BRT lanes to the "express" corridor from just south of Chapanoke Road to Mechanical Boulevard
- Widening the Tryon Road overpass
- Lengthening the US 70 flyover span
- Adding dedicated BRT access/exit ramps
- Adding BRT lanes and/or other treatments (such as signal prioritization, bypass lanes, and queue jumps) to connect ramps with Garner Station terminus

Grennelle Street/South Wilmington Street

The Southern Gateway Corridor Study recommends BRT service along South Wilmington Street, crossing over South Saunders Street onto a new roadway extending southward to Grennelle Street, which would be improved and extended to the Garner Station terminus.

Accommodating this BRT option requires the following changes to the recommended concept:

- Adding BRT lanes to the proposed Grennelle Street improvements and extension
- Either using signal prioritization/queue jumps/bypass lanes to reduce delay crossing Tryon Road, or constructing an overpass

Other Roadway Alternatives Considered

A wide range of appropriate solutions were evaluated in an iterative process of analysis and refinement leading to the study recommendations.

Tryon Road & US 70/US 401

No feasible at-grade intersection was identified. Even innovative concepts failed to provide adequate capacity without substantial and costly widening that had significant negative impacts on adjacent land uses, pedestrian safety and accessibility, and efficient intersection operations. Displaced Left-Turn (DLT), Median U-Turn (MUT), and Quadrant Roadway (QR) treatments were all evaluated and rejected because of poor performance and/or excessive right-of-way requirements.

A variety of interchanges were also considered, including Single-Point Urban Interchange (SPUI) and Diverging Diamond Interchange (DDI). Again, right-of-way impacts, geometric constraints, and poor performance eliminated these alternatives.

Garner Station Boulevard & US 401/Mechanical Boulevard & US 70

The close spacing of these two intersections (<700') combines with heavy through traffic and turning movements to require treating them as an interacting pair, rather than separate intersections. The braiding of US 70 and US 401 to the north results in several potentially redundant turning movements at each of these intersections. For example, eastbound traffic on Garner Station Road wishing to head north can turn left at either US 401 or US 70. Multiple attempts were made to more efficiently balance traffic between these two intersections, and to minimize conflicts, weaving, and potential queue back spill. Most of these solutions resulted in numerous turn restrictions that had particularly bad impacts on access to the Lowes retail center and other abutting commercial uses. Maintaining Mechanical Boulevard's continuity was especially challenging.

Grennelle Street & Tryon Road

Given the limited space between Grennelle Street and the US 70/US 401 intersection, some type of quadrant road on the west side of Grennelle Street is the only viable option providing full access at this location, even if a grade-separation is implemented.

Hammond Road & Tryon Road

At-grade intersection treatments considered at this location included additional widening, Quadrant Roadway, and Displaced Left-Turn. The Median U-Turn design performed best and had minimal right-of-way impacts.

Implementation

Estimates of Probable Costs

For planning purposes, estimates of probable costs are derived primarily from NCDOT construction cost per mile rates for widening and new construction of various cross-sections. Some costs per linear foot and square foot are used for utilities, structures, and some intersection improvements. A range of per-intersection costs were used for traffic signal additions or modifications, and a flat cost for superstreet intersection conversion.

Data from USDOT and other recent bus rapid transit projects informed BRT assumptions. No costs for stations or vehicles are included, only infrastructure associated with busways/bus lanes, including structures.

No right-of-way costs are included in any estimates. An additional 30% is added for miscellaneous costs and contingencies, and another 15% for engineering and construction costs.

Short-Term Improvements

The total estimated probable cost of the recommended short-term improvement projects is $6,000,000; however, the four projects are not interdependent, and can be implemented in any combination. Costs for individual projects range from $250,000 to $2,000,000. Table 12 summarizes estimated probable costs for these projects.

Table 12. Summary of Estimated Probable Costs-Short Term Projects.

Element	Limits	Subtotal	ROUNDED TOTAL
Garner Station intersection reconstruction	Garner Sta/US 401	$783,176	**$1,000,000**
Mechanical Blvd			**$2,000,000**
Reconstruct	US 401 - US 70	$1,549,364	
Terminate east of US 70	200' east of US 70	$310,892	
Convert S Wilmington Service Rd to RIRO at Tryon Rd	Tryon Rd/S Wilm St intersection	$165,356	**$250,000**
Signalize Tryon & Durham Roads	Tryon Rd/Durham Rd intersection	$547,034	**$750,000**
Realign NB US 70 (for longer weave)	1500' N of Mechanical Blvd	$1,957,940	**$2,000,000**
TOTAL		$5,313,762	**$6,000,000**

All rates based on NCDOT sources.

[1]Typical cost/mile for incremental widening or new construction.

[2]Rough estimate. Not included in **Misc** or **E&C** calculations.

[3]$14k/major intersection for new location

Long-Range Improvements

The total estimated cost for the set of recommended projects is $94.2 million, including $1.2 million for sidewalks. BRT improvements are not included in this total. Table 13 summarizes the costs of each roadway project element in the recommended plan:

- US 70/US 401 improvements plus parallel CD roads = $56,500,000
- Improvements to Tryon Road, including the Hammond Road intersection = $15,000,000
- Grennelle Street improvements (without an overpass) = $ 6,500,000
- Annaron Court improvements and extension = $ 4,500,000
- Mechanical/Garner Station Boulevard improvements = $ 4,000,000
- All other roadway projects = $ 6,500,000
- All sidewalk improvements = $ 1,200,000

The total estimated cost for the alternate project set (without grade separations at Garner Station and Mechanical Boulevards) is $77.2 million, including $1.2 million for sidewalks. BRT improvements are not included in this total. Table 14 summarizes the costs of each project element in the intermediate alternative:

- US 70/US 401 improvements plus parallel CD roads = $39,500,000
- Improvements to Tryon Road, including the Hammond Road intersection = $15,000,000
- Grennelle Street improvements (without an overpass) = $ 6,500,000
- Annaron Court improvements and extension = $ 4,500,000
- Mechanical/Garner Station Boulevard improvements = $ 4,000,000
- All other roadway projects = $ 6,500,000
- All sidewalk improvements = $ 1,200,000

Neither scenario includes an overpass for Grennelle Street at Tryon Road; this cost ($5,500,000) is estimated for information only.

BRT Improvements

The above cost estimates for long-range improvements do not include BRT infrastructure. Since there are two options being considered for the BRT route, two cost estimates were developed. Table 15 summarizes the incremental costs associated with each alternative.

- Grennelle Street BRT = $ 9,000,000
- US 70/US 401 BRT = $10,000,000

Both alternatives assume dedicated bus lanes for most of the indicated routes. In the US 70/US 401 option, any structural costs represent widenings or construction of parallel structures. The Grennelle Street option assumes BRT warrants a bridge over Tryon Road that would not otherwise be required. BRT structural costs are for bus lanes only, not general-purpose lanes.

Table 13. Summary of Estimated Probable Costs- Long-Range Projects.

Element	Limits	Subtotal	ROUNDED TOTAL
Tryon Rd			**$11,000,000**
Reconstruct	W of Ileagnes - Grennelle	$3,712,442	
Reconstruct	Grennelle - West CD Rd	$854,528	
Reconstruct & widen	West CD Rd - East CD Rd	$2,041,751	
Reconstruct	East CD Rd - Durham Rd	$2,372,463	
Reconstruct & add dual rght turn lanes; modify signal	Durham Rd - Hammond Rd	$1,274,148	
Reconstruct & add dual rght turn lanes	Durham Rd - 1000' east	$659,725	
Express Lanes			**$41,500,000**
5 lanes in median w/ret walls & fill, + bridge over Tryon	Chapanoke - Tryon	$10,875,659	
Assume 6 lanes total w/ ret walls & fill	Tryon - Flyover	$5,556,417	
US 401: 2 lane NB / 2 lanes SB	Flyover - Garner Sta	$2,131,508	
US 70: Assume 2 lane NB / 2 lanes SB, + flyover bridge	Flyover - Mech Blvd	$4,670,616	
US 401: 4 lanes w/ret walls & fill, + bridge over Garner Sta	Garner Sta - 1500' south	$9,214,093	
US 70: 4 lanes w/ret walls & fill, + bridge over Mech Blvd	Mech Blvd - 1500' south	$8,569,449	
CD/Local Lanes			**$15,000,000**
SB 2 lanes + turn lanes (reconstruction)	Chapanoke - Tryon	$1,262,256	
NB 2 lanes + turn lanes (reconstruction)	Chapanoke - Tryon	$1,262,256	
SB 2 lanes + turn lanes (reconstruction)	Tryon - Garner Sta	$2,440,984	
NB 2 lanes + turn lanes (reconstruction)	Tryon - Mech Blvd	$2,360,854	
US 401 ramps: 2 lanes SB / 2 lanes NB (reconstruction)	Garner Sta - ramp junction	$1,133,142	
US 70 ramps: 1 lane SB / 3 lanes NB (reconstruction)	Mech Blvd - ramp junction	$1,133,142	
US 401: 4 lanes SB / 3 lanes NB (reconstruction)	Ramp junction - 900' south	$2,647,679	
US 70: 3 lanes SB / 3 lanes NB (reconstruction)	Ramp junction - 900' south	$2,545,747	
Hammond Road			**$4,000,000**
Reconstruct and add median U-Turn	900' N of Tryon - Tryon	$1,840,719	
Reconstruct and add median U-Turn	Tryon - 900' S of Tryon	$1,815,236	
Grennelle Rd (no overpass)			**$6,500,000**
Assume widened to 4-lane divided	Olympia - Tryon	$1,133,142	
Extend 4-lane divided	Tryon - Garner Station	$3,146,295	
2 Quadrant roads (assume 3-lane)	Grennelle - Tryon	$2,010,888	
OPTIONAL: Overpass [4]			***$5,500,000***
Mechanical Blvd			**$2,500,000**
Assume 6 lanes	West CD Rd - East CD Rd	$1,184,674	
Widen to 4 lanes & realign	East CD Rd - 1000' south	$1,254,328	
Durham Dr			**$2,000,000**
Realign	N of Mech Blvd - US 70	$1,169,384	
Improve	End of C&G - N of Mech Blvd	$787,990	
Annaron Ct			**$4,500,000**
Widen	Existing	$2,021,648	
Extend	Existing - US 70	$2,348,679	
Garner Station	West CD Rd - 500' west	$1,085,857	**$1,500,000**
S Wilmington Service Rd: Realign	Tryon - East CD Rd	$917,670	**$1,000,000**
Texas U-Turn (south of Tryon)	Between CD Roads	$233,877	**$500,000**
New E-W collector/local streets	One per CD Road	$2,874,477	**$3,000,000**
TOTAL		$87,654,237	**$93,000,000**

All rates based on NCDOT sources.

[1]Typical cost/mile for incremental widening or new construction.

[2]Rough estimate. Not included in **Misc** or **E&C** calculations.

[3]$14k/major intersection for new location

[4]Overpass option eliminates need for $300,000 signal installation

Table 14. Summary of Estimated Probable Costs- Intermediate Alternative Long-Range Projects.

Element	Limits	Subtotal	ROUNDED TOTAL
Tryon Rd			**$11,000,000**
Reconstruct	W of Ileagnes - Grennelle	$3,712,442	
Reconstruct	Grennelle - West CD Rd	$854,528	
Reconstruct & widen	West CD Rd - East CD Rd	$2,041,751	
Reconstruct	East CD Rd - Durham Rd	$2,372,463	
Reconstruct & add dual rght turn lanes; modify signal	Durham Rd - Hammond Rd	$1,274,148	
Reconstruct & add dual rght turn lanes	Durham Rd - 1000' east	$659,725	
Express Lanes			**$23,500,000**
5 lanes in median w/ret walls & fill, + bridge over Tryon	Chapanoke - Tryon	$10,875,659	
Assume 6 lanes total w/ ret walls & fill	Tryon - Flyover	$5,556,417	
US 401: 2 lane NB / 2 lanes SB	Flyover - Garner Sta	$2,131,508	
US 70: Assume 2 lane NB / 2 lanes SB, + flyover bridge	Flyover - Mech Blvd	$4,670,616	
US 401: 4 lanes w/ret walls & fill, + bridge over Garner Sta	Garner Sta - 1500' south	$0	
US 70: 4 lanes w/ret walls & fill, + bridge over Mech Blvd	Mech Blvd - 1500' south	$0	
CD/Local Lanes			**$16,000,000**
SB 2 lanes + turn lanes (reconstruction)	Chapanoke - Tryon	$1,262,256	
NB 2 lanes + turn lanes (reconstruction)	Chapanoke - Tryon	$1,262,256	
SB 2 lanes + turn lanes (reconstruction)	Tryon - Garner Sta	$2,440,984	
NB 2 lanes + turn lanes (reconstruction)	Tryon - Mech Blvd	$2,360,854	
US 401 ramps: 2 lanes SB / 2 lanes NB (reconstruction)	Garner Sta - ramp junction	$0	
US 70 ramps: 1 lane SB / 3 lanes NB (reconstruction)	Mech Blvd - ramp junction	$0	
US 401: 4 lanes SB / 4 lanes NB (reconstruction)	Garner Sta - 1500' south	$4,358,435	
US 70: 4 lanes SB / 3 lanes NB (reconstruction)	Mech Blvdn - 1500' south	$4,188,548	
Hammond Road			**$4,000,000**
Reconstruct and add median U-Turn	900' N of Tryon - Tryon	$1,840,719	
Reconstruct and add median U-Turn	Tryon - 900' S of Tryon	$1,815,236	
Grennelle Rd (no overpass)			**$6,500,000**
Assume widened to 4-lane divided	Olympia - Tryon	$1,133,142	
Extend 4-lane divided	Tryon - Garner Station	$3,146,295	
2 Quadrant roads (assume 3-lane)	Grennelle - Tryon	$2,010,888	
OPTIONAL: Overpass [4]			***$5,500,000***
Mechanical Blvd			**$2,500,000**
Assume 6 lanes	West CD Rd - East CD Rd	$1,184,674	
Widen to 4 lanes & realign	East CD Rd - 1000' south	$1,254,328	
Durham Dr			**$2,000,000**
Realign	N of Mech Blvd - US 70	$1,169,384	
Improve	End of C&G - N of Mech Blvd	$787,990	
Annaron Ct			**$4,500,000**
Widen	Existing	$2,021,648	
Extend	Existing - US 70	$2,348,679	
Garner Station	West CD Rd - 500' west	$1,085,857	**$1,500,000**
S Wilmington Service Rd: Realign	Tryon - East CD Rd	$917,670	**$1,000,000**
Texas U-Turn (south of Tryon)	Between CD Roads	$233,877	**$500,000**
New E-W collector/local streets	One per CD Road	$2,874,477	**$3,000,000**
TOTAL		$70,957,969	**$76,000,000**

All rates based on NCDOT sources.
[1]Typical cost/mile for incremental widening or new construction.
[2]Rough estimate. Not included in **Misc** or **E&C** calculations.
[3]$14k/major intersection for new location
[4]Overpass option eliminates need for $300,000 signal installation

Table 15. Summary of Additional Estimated Probable Costs-BRT Options.

Grennelle Street BRT

Element	Limits	Subtotal	ROUNDED TOTAL
Grennelle Street			**$9,000,000**
2 lanes in median + bridge over Tryon[4,5]	Olympia - Tryon	$5,721,909	
2 lanes	Tryon - Garner Station	$3,057,955	
TOTAL		$8,779,863	**$9,000,000**

All rates adapted from NCDOT and USDOT sources.
[1]Typical cost/mile for incremental widening or new construction.
[2]Rough estimate. Not included in **Misc** or **E&C** calculations.
[3]$14k/major intersection for new location
[4]Overpass option eliminates need for $300,000 signal installation
[5]Cost for BRT bridge only

US 401 BRT

Element	*Limits*	*Subtotal*	*ROUNDED TOTAL*
Express Lanes			***$9,000,000***
2 lanes in median + bridge over Tryon	*Chapanoke - Tryon*	*$3,368,268*	
2 lanes	*Tryon - Flyover*	*$2,038,636*	
2 lanes + wider span	*Flyover - Garner Sta*	*$1,191,542*	
1 lane / direction	*Garner Sta -*	*$2,135,472*	
Garner Station *- 2 lanes*	*West CD Rd -*	*$861,324*	***$1,000,000***
TOTAL		*$9,595,242*	***$10,000,000***

All rates adapted from NCDOT and USDOT sources.
[1] Typical cost/mile for incremental widening or new construction.
*[2] Rough estimate. Not included in **Misc** or **E&C** calculations.*
[3] $14k/major intersection for new location

Phasing

The size and complexity of the recommended interchange project presents a daunting challenge for implementation. Construction will be lengthy and disruptive; an ambitious strategy will be needed to minimize road closures and provide reasonable alternate routes. An important first step would be to develop parallel capacity. There are several viable options, all of which will probably be warranted regardless of the status of US 70/US 401 improvements:

- Complete improvements to Timber Drive/Hammond Road. This underutilized route has substantial reserve capacity to accommodate longer (commute) trips to both Downtown and I-40. There are several potential "chokepoints" which can be mitigated:
    - Planned interchange at US 70 (U-5744)
    - Intersection improvements at Tryon Road (described in this study)
    - Minor enhancements of access into Downtown (north of Hoke Street)

- Extend and improve Grennelle Street, ideally as part of the South Wilmington Street Extension proposed in the Southern Gateway Corridor Study. Regardless of BRT status, this connection can relieve traffic on US 70/US 401, providing an alternate access route to Garner Station area.
- Improve and extend Durham Drive to provide another option accessing the area west of Hammond Road/Timber Drive.
- Implement proposed Collector-Distributor (C-D) Roads to maintain local access and provide through-traffic detour routes during US 70/US 401 bridge and roadway construction.
- Construct bridge over Tryon Road first, followed by US 401 bridge over Garner Station Boulevard, and finally US 70 over Mechanical Boulevard.

Other considerations:

- Some improvements to Tryon Road and Mechanical Boulevard can be completed in advance of major US 70/US 401 construction, if needed; other modifications are dependent on that construction.
- Extending and improving Annaron Court is not dependent on any other recommendations, although there are synergies.
- The BRT corridor alignment and station locations should be determined prior to detailed planning and design of the US 70/US 401 and Grennelle Street recommendations.