



Tap Root Farms
Traffic Impact Analysis
Henderson County , North Carolina
May 2020



TRAFFIC IMPACT ANALYSIS

FOR

TAP ROOT FARMS

LOCATED

IN

HENDERSON COUNTY, NORTH CAROLINA

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A handwritten signature in black ink that reads "Chase T. Smith".

May 2020

EXECUTIVE SUMMARY

This traffic impact study was performed to determine the potential impact to the transportation system caused by the additional traffic generated by the proposed development to be located on the north side of Butler Bridge Road, west of Interstate 26 in Henderson County, North Carolina. The site is expected to consist of 472 single-family homes and 227 townhomes and is anticipated to be completed by the end of 2028. In addition to site generated traffic, the study also considered the impact of background traffic growth within the study area.

On a typical weekday, it is estimated that the proposed development could generate a total of 444 trips (109 entering and 335 exiting) will occur during the AM peak hour and 573 trips (361 entering and 212 exiting) will occur during the PM peak hour.

Full movement access is to be provided via two (2) new driveway connection on Butler Bridge Road, with one located opposite Haw River Road and the other located approximately 650 feet [measured center-to-center] west of Yadkin Road.

The purpose of this study is to determine the potential impact to the transportation system caused by the additional traffic generated by proposed development. In order to accomplish this objective; this study analyzed the weekday AM and PM peak hours for the existing (2018) traffic conditions, future (2028) 'no build' traffic conditions, and future (2028) 'build' traffic conditions.

Intersection Capacity Analysis Summary

All the study area intersections (including the proposed site driveways) are expected to operate at acceptable levels-of-service under existing and future year conditions.

Queuing Analysis Summary

Based on a review of the maximum queuing results projected queues are not expected to extend back into adjacent intersections. Additionally, the projected queues are expected to be accommodated by existing and proposed turn lane storage lengths, except for the eastbound right turn lane on Butler Bridge Road at US 25 during the AM peak hour. Although the queue could potentially exceed the proposed storage [to be provided under STIP I-4400C] on occasion, the location of the bridge over I-26 prohibits the ability to provide any additional storage. No right turns were permitted at any signalized intersection for the purpose of this analysis; therefore, improved operations and decreased queues could be expected.

Based on the findings of this study, specific geometric improvements have been identified and are recommended to accommodate future traffic conditions.

US 25 and Butler Bridge Road

- Restripe the outbound lane on Butler Bridge Road [that drops as a left turn lane at North Rugby Road] to provide a second exclusive left turn lane at US 25. Maximize the storage and taper to provide equal storage for the back-to-back left turns between US 25 and North Rugby Road.

Butler Bridge Road and Haw River Road/Site Drive 1

- Provide a three-lane cross-section [for Site Drive 1] consisting of one ingress and two egress lanes. Stripe the egress to provide a shared left-through lane and an exclusive right turn lane. Per NCDOT's "Policy on Street and Driveway Access to North Carolina Highways", "a minimum storage of 100 feet measured from the near edge of the right-of-way will be required before any crossing or left-turning conflicts are allowed".

Butler Bridge Road and Site Drive 2

- Construct an exclusive left turn lane on the eastbound approach [of Butler Bridge Road]. Provide a minimum of 100 feet of full storage and appropriate taper lengths.
- Construct an exclusive westbound right turn lane on the westbound approach [of Butler Bridge Road]. Provide a minimum of 100 feet of full storage and appropriate taper lengths.
- Provide a three-lane cross-section [for Site Drive 2] consisting of one ingress and two egress lanes. Stripe the egress to provide exclusive left and right turn lanes. Per NCDOT's "Policy on Street and Driveway Access to North Carolina Highways", "a minimum storage of 100 feet measured from the near edge of the right-of-way will be required before any crossing or left-turning conflicts are allowed".

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TRAFFIC IMPACT ANALYSIS
TAP ROOT FARMS
HENDERSON COUNTY, NORTH CAROLINA

1. INTRODUCTION

This report summarizes the findings of the Traffic Impact Analysis (TIA) that was prepared for Tap Root Farms in Henderson County, North Carolina. The purpose of this study is to determine the potential impact to the transportation system caused by the additional traffic generated by proposed development, as well as recommend improvements to mitigate the impacts, if necessary.

The proposed development, anticipated to be completed in 2028, is expected to consist of 472 single-family homes and 227 townhomes.

The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- Existing (2018) Traffic Conditions
- Future (2028) 'No-Build' Traffic Conditions
- Future (2028) 'Build' Traffic Conditions
- Future (2028) 'Build' Traffic Conditions with Improvements [if necessary]

1.1. Site Location and Study Area

The site is located on the north side of Butler Bridge Road, west of Interstate 26 in Henderson County, North Carolina. Refer to Figure 1 for the site location map and Figure 2 for the conceptual site plan. The study area for the TIA was determined through coordination with the North Carolina Department of Transportation (NCDOT) and consists of the following existing intersections:

- Boylston Highway (NC 280) and Butler Bridge Road
- Ashville Highway (US 25) and Butler Bridge Road
- NC 280 and Fanning Fields Road
- Butler Bridge Road and Fanning Fields Road
- Butler Bridge Road and Jeffress Road/Carrie Lane

- Butler Bridge Road and Haw River Road/Site Access 1
- Butler Bridge Road and Yadkin Road
- Butler Bridge Road and North Rugby Road
- Butler Bridge Road and Site Access 2

Refer to Appendix A for a copy of the NCDOT TIA Scoping Checklist.

1.2. Proposed Land Use and Site Access

The proposed development, anticipated to be completed in 2028, is expected to consist of 472 single-family homes and 227 townhomes.

Full movement access is to be provided via two (2) new driveway connection on Butler Bridge Road, with one located opposite Haw River Road and the other located approximately 650 feet [measured center-to-center] west of Yadkin Road.

1.3. Adjacent Land Uses

The proposed development is located in an area consisting primarily of farmland and residential uses.

1.4. Existing Roadways

Existing lane configurations (number of traffic lanes on each intersection approach), lane widths, storage capacities, and other intersection and roadway information within the study area are shown in Figure 3. Table 1 provides a summary of this information, as well.



Table 1: Existing Roadway Inventory

Road Name	Route Number	Typical Cross Section	Speed Limit	Maintained By	2018 AADT (vpd)
Boylston Highway	NC 280	4-lane divided	55 mph	NCDOT	22,000
Ashville Highway	US 25	5-lane undivided	45 mph	NCDOT	30,000
Butler Bridge Road	SR 1345 / SR 1351	2-lane undivided	35 mph	NCDOT	7,900
Fanning Fields Road	SR 1354	2-lane undivided	35 mph	NCDOT	4,100*
Jeffress Road	SR 1345	2-lane undivided	45 mph	NCDOT	1,600
Carrie Lane	--	2-lane undivided	Unposted	Local	<100*
Haw River Road	--	2-lane undivided	Unposted	Local	1,100*
Yadkin Road	--	2-lane undivided	Unposted	Local	1,800*
North Rugby Road	SR 1365	2-lane undivided	45 mph	NCDOT	5,800

*Estimated Annual Average Daily Traffic (AADT) assuming PM peak hour traffic accounts for 10% of AADT.



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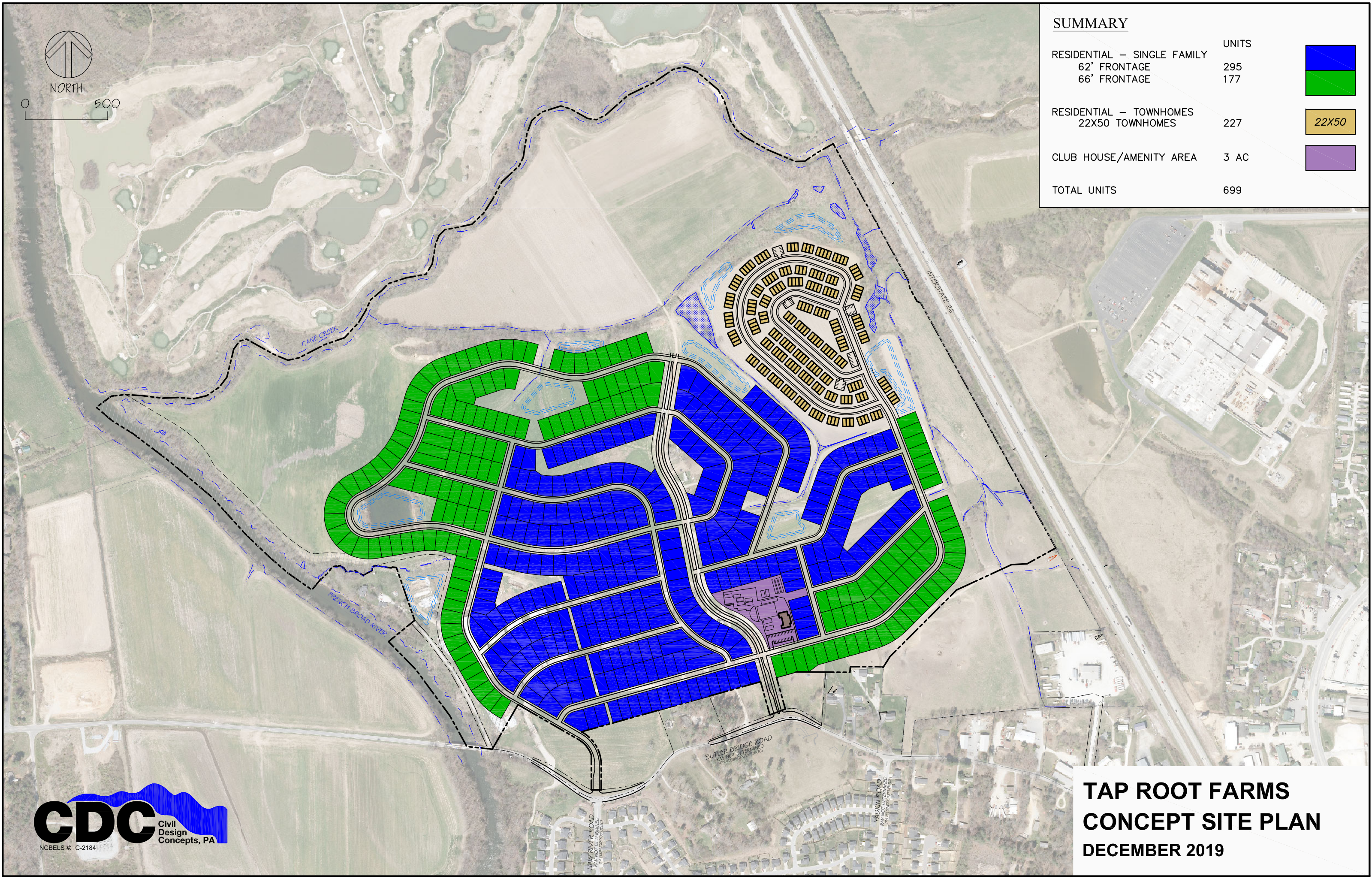
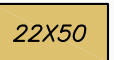
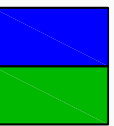
-  Site Location
-  Existing Study Intersections

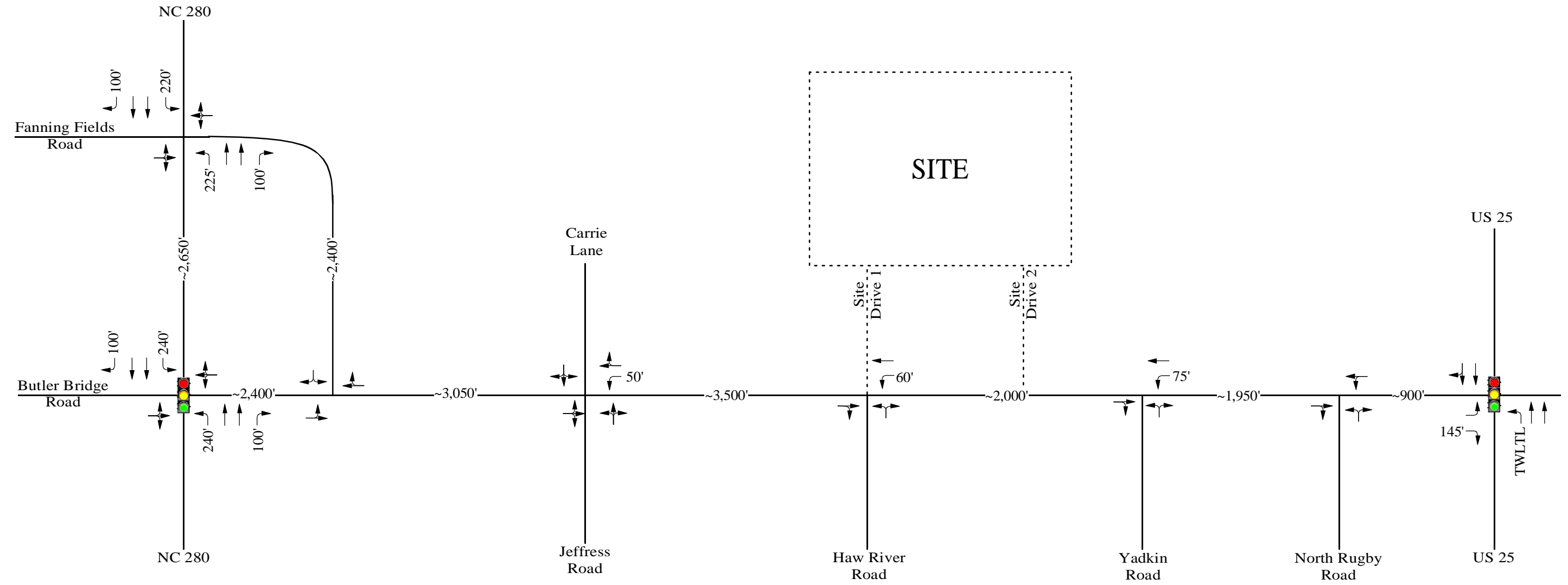
	Tap Root Farms Henderson County, NC	Site Location Map	
		Not to Scale	Figure 1




SUMMARY


	UNITS
RESIDENTIAL – SINGLE FAMILY	
62' FRONTAGE	295
66' FRONTAGE	177
RESIDENTIAL – TOWNHOMES	
22X50 TOWNHOMES	227
CLUB HOUSE/AMENITY AREA	3 AC
TOTAL UNITS	699





LEGEND

-  Signalized Intersection
- X' → Existing Lane Configuration and Storage Length (in feet)
- ~X' Existing Link Distance (in feet)

 <p>Moving forward. RKA RAMEY KEMP ASSOCIATES</p>	Tap Root Farms Henderson County, NC	Existing Geometrics and Traffic Control	
		Not to Scale	Figure 3

2. EXISTING (2018) PEAK HOUR CONDITIONS

2.1. Existing (2018) Peak Hour Traffic

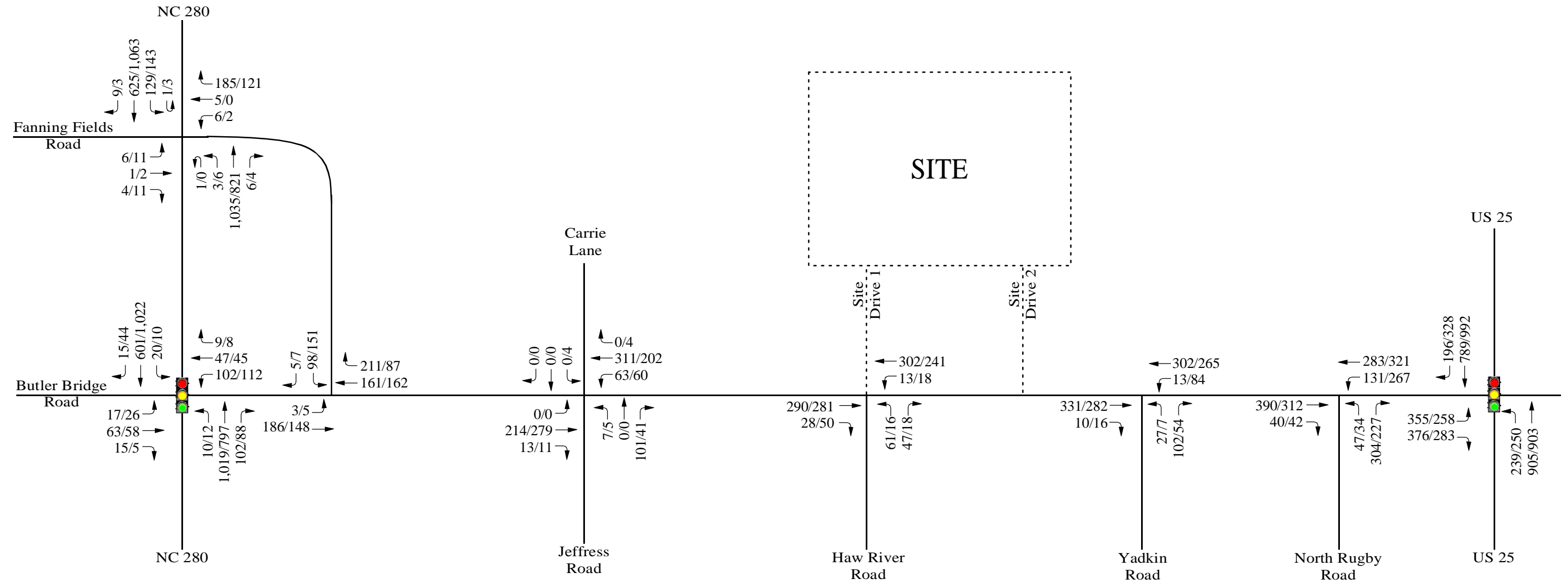
Existing peak hour traffic volumes were determined based on traffic counts conducted at the study intersections listed below, in December of 2018, during typical weekday AM (7:00 AM – 9:00 AM) and PM (4:00 PM – 6:00 PM) peak periods while schools were in session:

- NC 280 and Butler Bridge Road
- (US 25 and Butler Bridge Road
- NC 280 and Fanning Fields Road
- Butler Bridge Road and Fanning Fields Road
- Butler Bridge Road and Jeffress Road/Carrie Lane
- Butler Bridge Road and Haw River Road
- Butler Bridge Road and Yadkin Road
- Butler Bridge Road and North Rugby Road


Refer to Figure 4 for existing (2018) weekday AM and PM peak hour traffic volumes. Please note that traffic volumes were balanced upwards on NC 280 between Butler Bridge Road and Fanning Fields Road since there are no connections located between them. As for traffic volumes A copy of the raw count data is located in Appendix B of this report.


2.2. Analysis of Existing (2018) Peak Hour Traffic

The existing (2018) weekday AM and PM peak hour traffic volumes were analyzed to determine the current levels of service at the study intersections under existing roadway conditions. Signal information was obtained from NCDOT and is included in Appendix C. The results of the analysis are presented in Section 7 of this report.



LEGEND

-  Signalized Intersection
- X/Y AM/PM Peak Hour Traffic

	Tap Root Farms Henderson County, NC	Existing (2018) Traffic Volumes	
		Not to Scale	Figure 4

3. FUTURE (2028) 'NO-BUILD' PEAK HOUR CONDITIONS

In order to account for growth of traffic and subsequent traffic conditions at a future year, background traffic projections are needed. Background traffic is the component of traffic due to the growth of the community and surrounding area that is anticipated to occur regardless of whether or not the proposed development is constructed. Background traffic is comprised of existing traffic growth within the study area and additional traffic created as a result of adjacent approved developments.

3.1. Ambient Traffic Growth

Through coordination with NCDOT, it was determined that an annual growth rate of 1% would be used to generate future (2028) 'no-build' weekday AM and PM peak hour traffic volumes.

3.2. Adjacent Development Traffic

Based on coordination with the NCDOT, it was determined there were no adjacent developments to consider with this study.

3.3. Future Roadway Improvements

Based on coordination with the NCDOT it was determined that there is an NCDOT State Transportation Improvements Program (STIP) project that is to be completed prior to build out of the proposed development: I-4400C. The following improvements are expected to be provided as part of STIP I-4400C:

- The bridge on Butler Bridge Road [over Interstate 26] is proposed to be widened from 2 lanes to 3 lanes to provide an exclusive left turn lane on Butler Bridge Road at North Rugby Road.
- The existing eastbound right turn lane on Butler Bridge Road [at US 25] is proposed to be extended with the bay taper starting at the bridge to maximize the right turn storage.
- North Rugby Road is to be widened to provide an exclusive left turn lane and right turn lane onto Butler Bridge Road.
- A traffic signal is to be installed at the intersection of Butler Bridge Road and North Rugby Road.

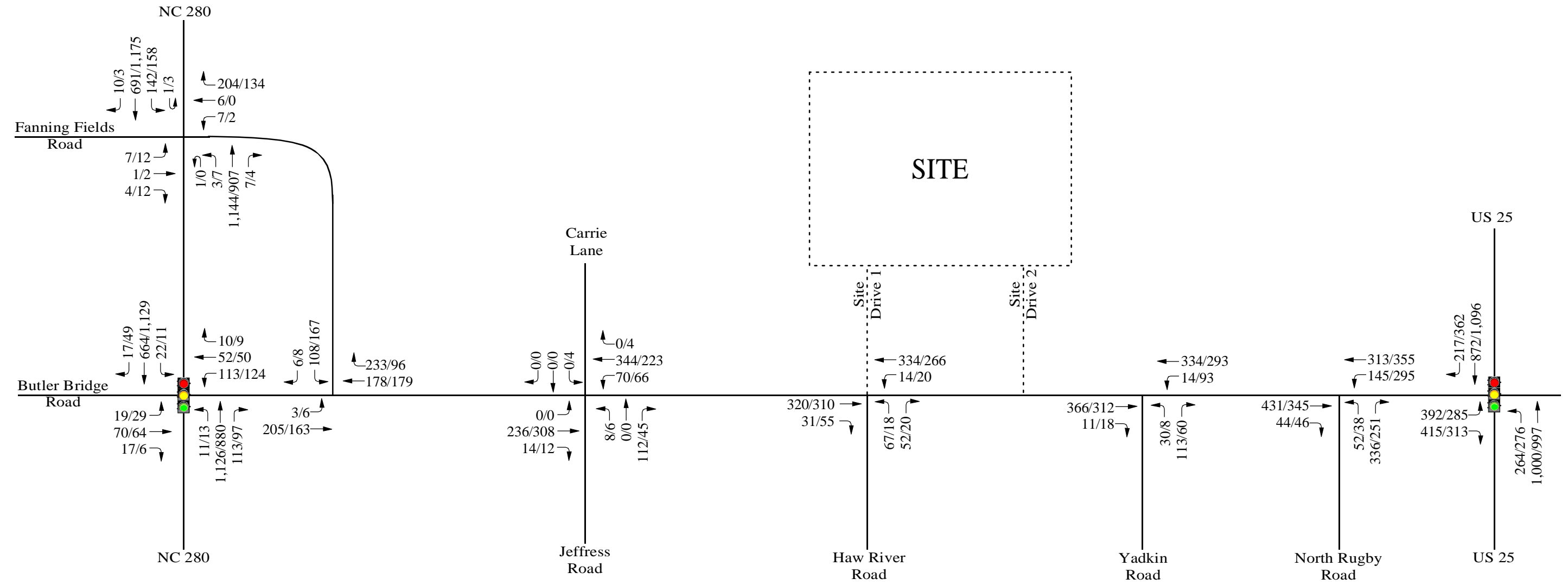
Refer to Appendix D for the roadway plans and signal plans associated with STIP I-4400C.

3.4. Future (2028) 'No-Build' Peak Hour Traffic Volumes


Refer to Figure 5 for an illustration of the future (2028) 'no-build' peak hour traffic volumes at the study intersections.


3.5. Analysis of Future (2028) 'No-Build' Peak Hour Traffic Conditions

The future (2028) 'no-build' AM and PM peak hour traffic volumes at the study intersections were analyzed with existing lane configurations and traffic control, in addition to the improvements associated with the NCDOT STIP project. Please note that any left turn movements that operated under permitted-protected phasing under existing conditions were analyzed under protected-only phasing for the purpose of this analysis. In addition, no right turns on red were permitted at any traffic signals. The analysis results are presented in Section 7 of this report.



LEGEND

-  Signalized Intersection
- X/Y AM/PM Peak Hour Traffic

 <p>Moving forward. RKA RAMEY KEMP ASSOCIATES</p>	Tap Root Farms Henderson County, NC	Future (2028) 'No-Build' Traffic Volumes
		Not to Scale Figure 5

4. SITE TRIP GENERATION AND DISTRIBUTION

4.1. Trip Generation

The proposed development is assumed to consist of 472 single-family homes and 227 townhomes. Average weekday daily, AM peak hour, and PM peak hour trips for the proposed development were estimated using methodology contained within the ITE Trip Generation Manual, 10th Edition. Table 2 provides a summary of the trip generation potential for the site.

Table 2: Trip Generation Summary

Land Use (ITE Code)	Intensity	Daily Traffic (vpd)	AM Peak Hour Trips (vph)		PM Peak Hour Trips (vph)	
			Enter	Exit	Enter	Exit
Single-Family Detached Housing (210)	472 dwelling units	4,335	85	255	284	167
Low-Rise Multifamily Housing (220)	227 dwelling units	1,675	24	80	77	45
Total Trips		6,010	109	335	361	212

It is estimated that the proposed development will generate approximately 6,010 total trips during a typical 24-hour weekday period. Of the daily traffic volume, it is anticipated 444 trips (109 entering and 335 exiting) will occur during the AM peak hour and 573 trips (361 entering and 212 exiting) will occur during the PM peak hour.

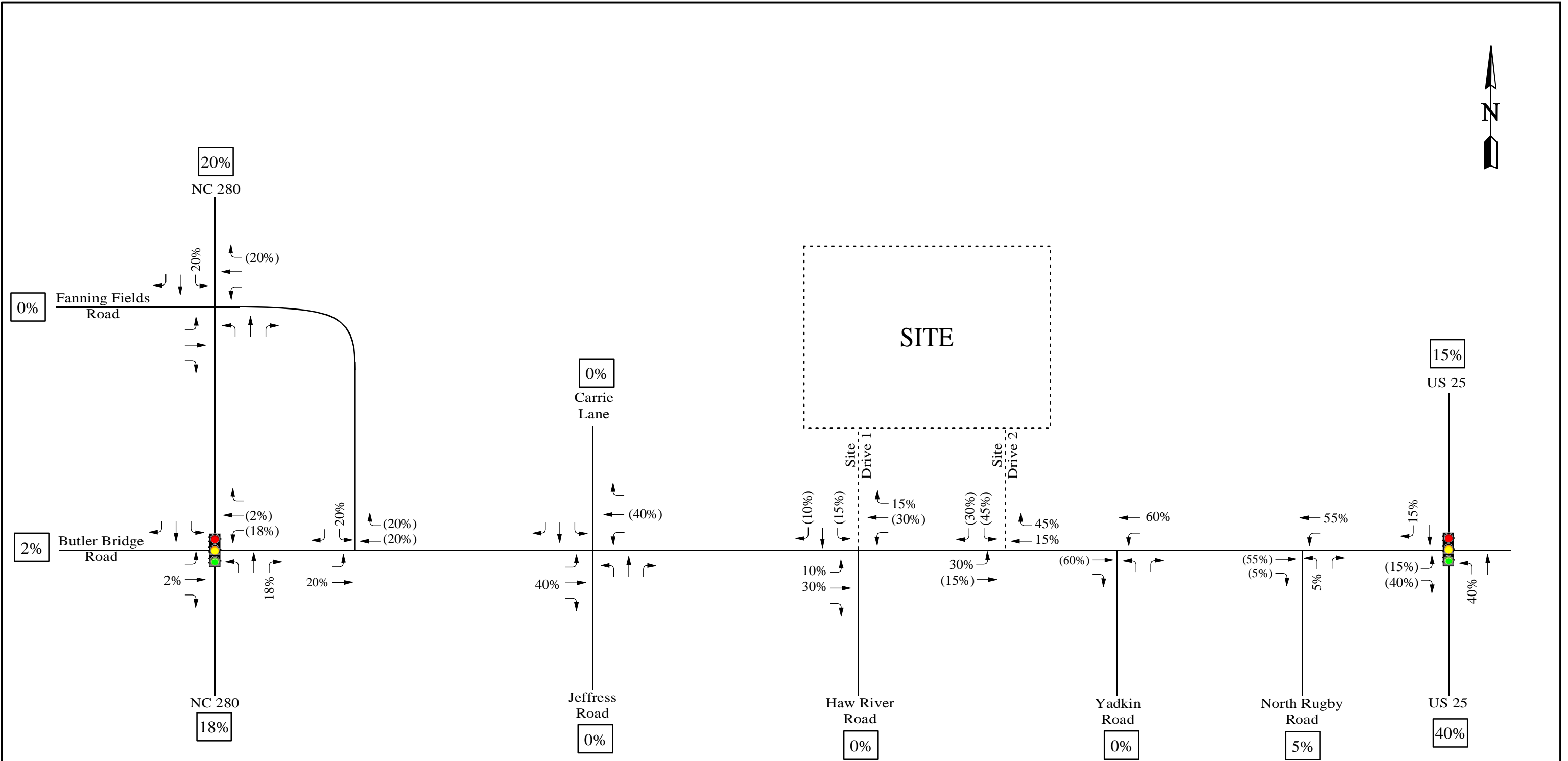
4.2. Site Trip Distribution and Assignment

Trip distribution percentages used in assigning site traffic for this development were estimated based on a combination of existing traffic patterns, population centers adjacent to the study area, and engineering judgment.


The site trip distribution will be distributed as follows:

- 15% to/from the north via US 25
- 40% to/from the south via US 25
- 20% to/from the north via NC 280
- 18% to/from the south via NC 280
- 5% to/from the south via North Rugby Road
- 2% to/from the west via Butler Bride Road

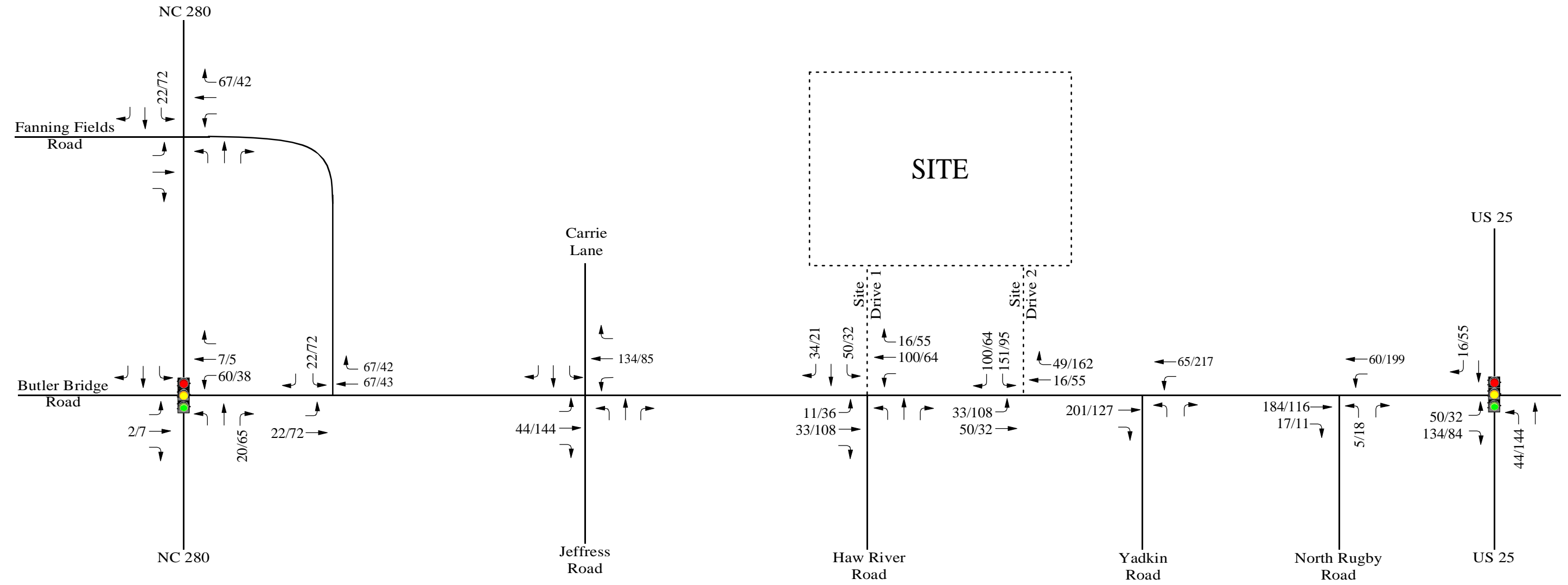
Refer to figures 6 and 7 for illustrations of the site trip distribution and assignment.




LEGEND


-  Signalized Intersection
- X% Regional Trip Distribution
- X% Entering (Y%) Exiting Peak Hour Site Traffic

<p>Moving forward.</p>  <p>RKA</p> <p>RAMEY KEMP ASSOCIATES</p>	<p>Tap Root Farms Henderson County, NC</p>	<p>Site Trip Distribution</p>
		<p>Not to Scale Figure 6</p>



LEGEND

-  Signalized Intersection
- X/Y AM/PM Peak Hour Site Traffic

	Tap Root Farms Henderson County, NC	Site Trip Assignment	
		Not to Scale	Figure 7

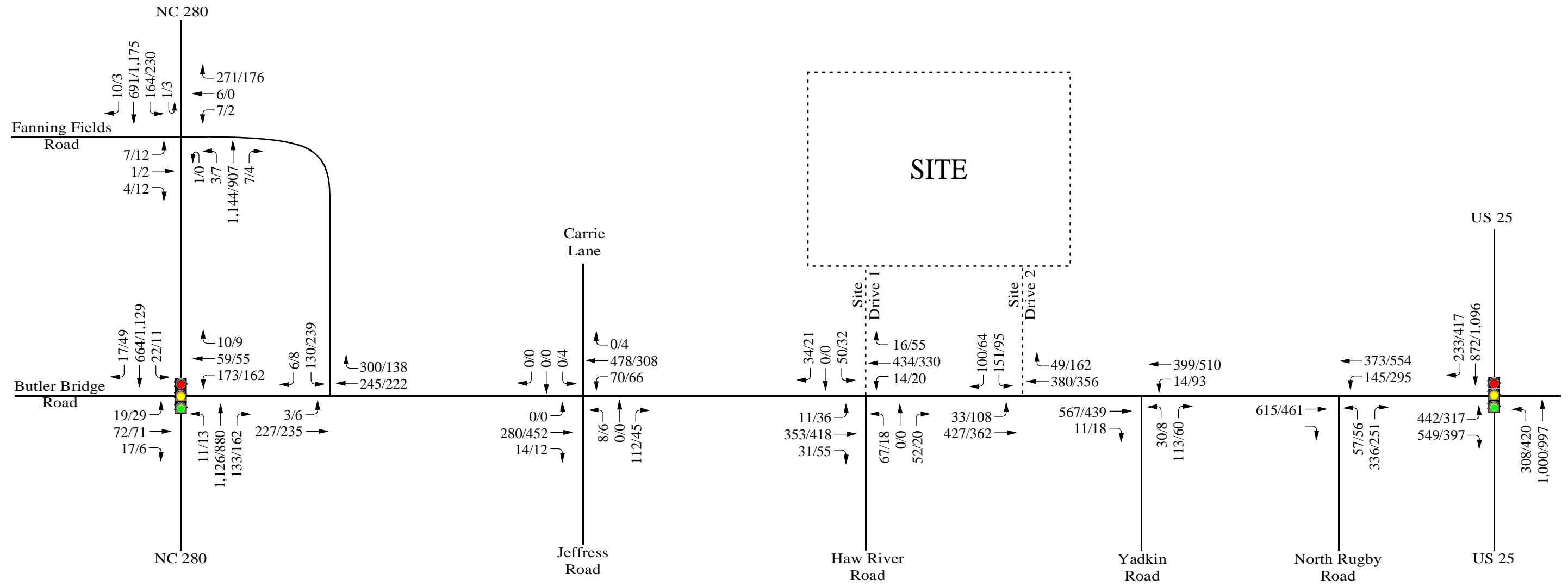
5. FUTURE (2028) 'BUILD' TRAFFIC CONDITIONS

5.1. Future (2028) 'Build' Peak Hour Traffic Volumes

To estimate traffic conditions with the site fully built out, the total site trips were added to the future (2028) 'no-build' traffic volumes to determine the future (2028) 'build' traffic volumes. Refer to Figure 8 for an illustration of the future (2028) 'build' peak hour traffic volumes with the proposed site fully developed.

5.2. Analysis of Future (2028) 'Build' Peak Hour Traffic

Study intersections were analyzed with the future (2028) 'build' traffic volumes using the same methodology previously discussed for future 'no-build' traffic conditions. The results of the capacity analysis for each intersection are presented in Section 7 of this report.



LEGEND



Signalized Intersection

X/Y AM/PM Peak Hour Traffic

<p>Moving forward. RKA RAMEY KEMP ASSOCIATES</p>	Tap Root Farms Henderson County, NC	Future (2028) 'Build' Traffic Volumes	
		Not to Scale	Figure 8

6. TRAFFIC ANALYSIS PROCEDURE

Study intersections were analyzed using the methodology outlined in the Highway Capacity Manual, 6th Edition (HCM) published by the Transportation Research Board. Capacity and level of service are the design criteria for this traffic study. A computer software package, Synchro (Version 10.3), was used to complete the analyses for most of the study area intersections. Please note that the unsignalized capacity analysis does not provide an overall level of service for an intersection; only delay for an approach with a conflicting movement.

The HCM defines capacity as “the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions.” Level of service (LOS) is a term used to represent different driving conditions and is defined as a “qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers.” Level of service varies from Level “A” representing free flow, to Level “F” where breakdown conditions are evident. Refer to Table 3 for HCM levels of service and related average control delay per vehicle for both signalized and unsignalized intersections. Control delay as defined by the HCM includes “initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay”. An average control delay of 50 seconds at a signalized intersection results in LOS “D” operation at the intersection.

Table 3: Highway Capacity Manual – Levels of Service and Delay

SIGNALIZED INTERSECTION		UNSIGNALIZED INTERSECTION	
LEVEL OF SERVICE	AVERAGE CONTROL DELAY PER VEHICLE (SECONDS)	LEVEL OF SERVICE	AVERAGE CONTROL DELAY PER VEHICLE (SECONDS)
A	0-10	A	0-10
B	10-20	B	10-15
C	20-35	C	15-25
D	35-55	D	25-35
E	55-80	E	35-50
F	>80	F	>50

6.1 Adjustments to Analysis Guidelines

Capacity analysis at all study intersections was completed according to the NCDOT Congestions Management Guidelines.

7. CAPACITY ANALYSIS

7.1. NC 280 and Butler Bridge Road

The existing signalized intersection of NC 280 and Butler Bridge Road was analyzed under existing, 'no-build', and 'build' traffic conditions with existing lane configurations and traffic control. Refer to Table 4 for a summary of the analysis results. Refer to Appendix E for the Synchro capacity analysis reports.

Table 4: Analysis Summary of NC 280 and Butler Bridge Road

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	NB SB EB WB	1 LT, 2 TH, 1 RT 1 LT, 2 TH, 1 RT 1 LT-TH-RT 1 LT-TH-RT	B (11.3) A (8.3) C (33.7) D (46.4)	B (14.1)	A (9.0) B (10.4) C (33.5) D (43.8)	B (13.2)
'No-Build' (2028) Conditions	NB SB EB WB	1 LT, 2 TH, 1 RT 1 LT, 2 TH, 1 RT 1 LT-TH-RT 1 LT-TH-RT	B (16.8) B (12.0) C (28.6) C (34.2)	B (17.2)	B (13.3) B (15.3) C (25.0) C (30.0)	B (16.0)
'Build' (2028) Conditions	NB SB EB WB	1 LT, 2 TH, 1 RT 1 LT, 2 TH, 1 RT 1 LT-TH-RT 1 LT-TH-RT	C (20.4) B (14.6) C (26.9) D (36.5)	C (20.6)	B (14.6) B (19.5) C (26.5) C (34.4)	B (19.1)

Capacity analysis indicates that the intersection is expected to operate at an overall LOS C or better during the weekday AM and PM peak hours under all existing and future traffic conditions. In addition, all intersection approaches are expected to operate at LOS D or better under all existing and future traffic conditions during the weekday AM and PM peak hours. While the need for mitigation improvements should be addressed if the average delay at an intersection or individual approach increases by 25% or more while maintaining same level of service of the level of service degrades by at least one level, no mitigation was identified considering the overall intersection and approach delays are not expected to increase by more than 4.5 seconds per vehicle and are expected to operate at acceptable levels of service.

7.2. US 25 and Butler Bridge Road

The existing signalized intersection of US 25 and Butler Bridge Road was analyzed under existing, ‘no-build’, and ‘build’ traffic conditions with existing lane configurations and traffic control in addition to the improvements associated with the NCDOT STIP project [under all future traffic conditions]. Refer to Table 5 for a summary of the analysis results. Refer to Appendix F for the Synchro capacity analysis reports.

Table 5: Analysis Summary of US 25 and Butler Bridge Road

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	NB SB EB	1 LT, 2 TH 1 TH, 1 TH-RT 1 LT, 1 RT	B (13.6) C (26.8) D (42.8)	C (25.6)	B (16.7) C (30.5) D (47.7)	C (28.3)
‘No-Build’ (2028) Conditions	NB SB EB	1 LT, 2 TH 1 TH, 1 TH-RT 1 LT, 1 RT	C (25.1) D (40.1) D (43.8)	D (35.0)	C (25.1) D (42.9) E (59.3)	D (39.1)
‘Build’ (2028) Conditions	NB SB EB	1 LT, 2 TH 1 TH, 1 TH-RT 1 LT, 1 RT	C (30.0) D (48.4) D (49.9)	D (41.8)	D (41.3) E (79.8) E (72.2)	E (63.3)
‘Build’ (2028) Conditions [with improvements]	NB SB EB	1 LT, 2 TH 1 TH, 1 TH-RT 2 LT, 1 RT	B (18.8) C (31.9) D (50.1)	C (32.2)	C (27.9) D (46.3) E (68.5)	D (43.5)

Bold denotes lane reconfiguration and/or improvement to be provided by developer.

Capacity analysis indicates that the intersection is expected to operate at an overall LOS D or better during the weekday AM and PM peak hours under all existing and future traffic conditions except for the PM peak hour under ‘build’ conditions. In addition, all intersection approaches are expected to operate at LOS D or better under all existing and future traffic conditions, with the exceptions of the southbound approach of US 25 [‘build’ conditions] and the eastbound approach of Butler Bridge Road [‘no-build’ and ‘build’ conditions] during the PM peak hour.

Because the overall intersection and southbound approach [of US 25] are expected to decrease

from LOS D to LOS E when comparing ‘build’ to ‘no-build’ conditions, mitigation was identified. With an additional [exclusive] left turn lane provided on the eastbound approach of Butler Bridge Road, the intersection and its approaches are expected to operate at levels similar to those expected under ‘no-build’ conditions.

7.3. NC 280 and Fanning Fields Road

The existing unsignalized intersection of NC 280 and Fanning Fields Road was analyzed under existing, ‘no-build’, and ‘build’ traffic conditions with existing lane configurations and traffic control. Refer to Table 6 for a summary of the analysis results. Refer to Appendix G for the Synchro capacity analysis reports.

Table 6: Analysis Summary of NC 280 and Fanning Fields Road [Unsignalized]

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	NB ¹	1 LT, 2 TH, 1 RT	B (10.6)	N/A	B (11.2)	N/A
	SB ¹	1 LT, 2 TH, 1 RT	B (13.8)		B (11.6)	
	EB ²	1 LT-TH-RT	F (134.4)		F (255.7)	
	WB ²	1 LT-TH-RT	C (18.2)		C (17.0)	
‘No-Build’ (2028) Conditions	NB ¹	1 LT, 2 TH, 1 RT	B (11.1)	N/A	C (16.2)	N/A
	SB ¹	1 LT, 2 TH, 1 RT	C (16.0)		B (12.6)	
	EB ²	1 LT-TH-RT	F (333.8)		F (639.8)	
	WB ²	1 LT-TH-RT	D (31.7)		D (29.9)	

1. Level of service for major street left turn movement.
2. Level of service for minor stop-controlled approach.

Capacity analysis indicates the major street left turn movement [on NC 280] is expected to operate at LOS C or better during the weekday AM and PM peak hours under existing and future ‘no-build’ traffic conditions. The minor stop-controlled approaches [of Fanning Field Road] are expected to operate at LOS D or better except for the eastbound approach.

At the request of NCDOT, a traffic signal warrant analysis was performed at the intersection of NC 280 and Fanning Fields Road. It was understood that an analysis had been performed years ago, but the intersection did not warrant a traffic signal at that time.

A traffic signal should be warranted prior to its installation and operation. The Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) has national standardized criteria for determining the warrants for traffic signals. Some warrants are based on actual or historical data such as accident history, pedestrian activity, or minor street delay. Other warrants compare the major street and minor street volumes to volume thresholds for various lengths of time for an average weekday.

Signal warrants criteria are based primarily on traffic volumes and vary based on the number of travel lanes on both the major and minor streets and travel speed on the major street. For this analysis, and 85th percentile vehicle speed on NC 280 is 40 miles per hour (mph) or greater since the posted speed limit is 55 mph.

Existing traffic volumes at the intersection of NC 280 and Fanning Fields Road were obtained from 12-hour turning movement counts. The existing traffic volumes were projected to the horizon year 2028 by applying an annual growth of 1.0%, as previously discussed. A summary of the existing and projected hourly traffic volumes can be found in Appendix G.

The intersection was analyzed with the future (2028) 'no-build' traffic volumes and existing lane configurations. The existing configuration of the major approaches of NC 280 consist of 2 or more lanes while the approaches of Fanning Fields Road consist of a shared left-through-right lanes; therefore, the minor approaches were analyzed as one-lane approaches. A summary of the traffic signal warrant analysis results is presented in Table 7.

Table 7: Signal Warrant Analysis Results

TIME PERIOD	VEHICLE COUNT		WARRANTS			
	MAJOR	MINOR	1A	1B	2	3
7 AM to 8 AM	1,895	204	Y	Y	Y	Y
8 AM to 9 AM	1,453	112	Y	Y	Y	Y
9 AM to 10 AM	1,336	82	N	Y	Y	Y
10 AM to 11 AM	1,380	74	N	Y	Y	N
11 AM to 12 AM	1,503	100	N	Y	Y	Y
12 AM to 1 PM	1,594	115	Y	Y	Y	Y
1 PM to 2 PM	1,503	104	N	Y	Y	Y
2 PM to 3 PM	1,750	95	N	Y	Y	Y
3 PM to 4 PM	1,898	140	Y	Y	Y	Y
4 PM to 5 PM	2,150	114	Y	Y	Y	Y
5 PM to 6 PM	2,065	121	Y	Y	Y	Y
6 PM to 7 PM	1,442	63	N	Y	Y	N
Number of Periods Met			6	12	12	10
Number of Periods Required			8	8	4	1
WARRANTS MET			NO	YES	YES	YES

Based on the results of the traffic signal warrant analysis (refer to Section 4), the installation of a traffic signal is warranted at this location. Considering this, expected delays, and NCDOT's past analysis, the intersection of NC 280 and Fanning Fields Road was analyzed under signalized conditions under all future traffic conditions.

Table 8: Analysis Summary of NC 280 and Fanning Fields Road [Signalized]

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
'No-Build' (2028) Conditions	NB	1 LT, 2 TH, 1 RT	C (24.8)	C (22.2)	C (22.1)	B (16.8)
	SB	1 LT, 2 TH, 1 RT	B (13.5)		B (10.9)	
	EB	1 LT-TH-RT	C (32.6)		C (30.2)	
	WB	1 LT-TH-RT	D (41.6)		D (35.6)	
'Build' (2028) Conditions	NB	1 LT, 2 TH, 1 RT	C (28.2)	C (26.1)	C (26.8)	C (20.2)
	SB	1 LT, 2 TH, 1 RT	B (16.6)		B (13.4)	
	EB	1 LT-TH-RT	C (32.0)		C (30.7)	
	WB	1 LT-TH-RT	D (46.7)		D (38.8)	

With a traffic signal installed on NC 280 at Fanning Fields Road, capacity analysis indicates that the signalized intersection is expected to operate at an overall LOS C or better during the AM and PM peak hours. In addition, all intersection approaches are expected to operate at LOS D or better. While the need for mitigation improvements should be addressed if the level of service degrades by at least one level, no mitigation was identified considering the overall intersection delay is not expected to increase by more than 3.5 seconds per vehicle and is expected to operate at an acceptable level of service.

7.4. Butler Bridge Road and Fanning Field Road

The existing unsignalized intersection of Butler Bridge Road and Fanning Field Road was analyzed under existing, 'no-build', and 'build' traffic conditions with existing lane configurations and traffic control. Refer to Table 9 for a summary of the analysis results. Refer to Appendix H for the Synchro capacity analysis reports.

Table 9: Analysis Summary of Butler Bridge Road and Fanning Field Road

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	EB ¹ WB SB ²	1 LT-TH 1 TH-RT 1 LT-RT	A (8.2) - B (13.7)	N/A	A (7.8) - B (13.3)	N/A
'No-Build' (2028) Conditions	EB ¹ WB SB ²	1 LT-TH 1 TH-RT 1 LT-RT	A (8.3) - B (14.8)	N/A	A (7.9) - B (14.5)	N/A
'Build' (2028) Conditions	EB ¹ WB SB ²	1 LT-TH 1 TH-RT 1 LT-RT	A (8.7) - C (18.8)	N/A	A (8.1) - C (23.1)	N/A

1. Level of service for major street left turn movement.
2. Level of service for minor stop-controlled approach.

Capacity analysis indicates the major street left turn movement [on Butler Bridge Road] is expected to operate at LOS A during the weekday AM and PM peak hours under all existing and future traffic conditions. The minor stop-controlled approach [of Fanning Field Road] is expected to operate at LOS C or better during the weekday AM and PM peak hours. While the need for mitigation improvements should be addressed if the level of service degrades by at least one level, no mitigation was identified considering the approach delays are not expected to increase by more than 9.0 seconds per vehicle and is expected to operate at acceptable levels of service.

7.5. Butler Bridge Road and Jeffress Road/Carrie Lane

The existing unsignalized intersection of Butler Bridge Road and Jeffress Road/Carrie Lane was analyzed under existing, 'no-build', and 'build' traffic conditions with existing lane configurations and traffic control. Refer to Table 10 for a summary of the analysis results. Refer to Appendix I for the Synchro capacity analysis reports.

Table 10: Analysis Summary of Butler Bridge Road and Jeffress Road/Carrie Lane

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	EB ¹	1 LT-TH-RT	A (8.0)	N/A	A (7.7)	N/A
	WB ¹	1 LT, 1 TH-RT	A (7.9)		A (8.1)	
	NB ²	1 LT-TH-RT	A (9.8)		A (9.4)	
	SB ²	1 LT-TH-RT	C (15.3)		B (14.0)	
'No-Build' (2028) Conditions	EB ¹	1 LT-TH-RT	A (8.1)	N/A	A (7.8)	N/A
	WB ¹	1 LT, 1 TH-RT	A (8.0)		A (8.2)	
	NB ²	1 LT-TH-RT	B (10.0)		A (9.6)	
	SB ²	1 LT-TH-RT	C (16.6)		B (14.9)	
'Build' (2028) Conditions	EB ¹	1 LT-TH-RT	A (8.5)	N/A	A (8.0)	N/A
	WB ¹	1 LT, 1 TH-RT	A (8.1)		A (8.7)	
	NB ²	1 LT-TH-RT	B (10.4)		B (10.7)	
	SB ²	1 LT-TH-RT	C (20.7)		C (19.4)	

1. Level of service for major street left turn movement.
2. Level of service for minor stop-controlled approach.

Capacity analysis indicates the major street left turn movements [on Butler Bridge Road] are expected to operate at LOS A during the weekday AM and PM peak hours under all existing and future traffic conditions. The minor stop-controlled approaches [of Jeffress Road and Carrie Lane] are expected to operate at LOS C or better during the weekday AM and PM peak hours. While the need for mitigation improvements should be addressed if the level of service degrades by at least one level, no mitigation was identified considering the delays on the side-street approaches are not expected to increase by more than 4.5 seconds per vehicle and are expected to operate at acceptable levels of service.

7.6. Butler Bridge Road and Haw River Road/Site Drive 1

The existing unsignalized intersection of Butler Bridge Road and Haw River Road was analyzed under existing, ‘no-build’, and ‘build’ traffic conditions with existing lane configurations and traffic control, in addition to any NCDOT warranted turn lanes at the site access. Based on the future ‘build’ traffic volumes, no auxiliary turn lanes are necessary at the proposed site driveway. Refer to Table 11 for a summary of the analysis results. Refer to Appendix J for the Synchro capacity analysis reports, and Appendix N for the NCDOT turn lane warrant charts with the future ‘build’ traffic volumes charted.

Table 11: Analysis Summary of Butler Bridge Road and Haw River Road/Site Drive 1

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	EB WB ¹ NB ²	1 TH-RT 1 LT, 1 TH 1 LT-RT	- A (8.0) B (14.7)	N/A	- A (8.1) B (12.2)	N/A
‘No-Build’ (2028) Conditions	EB WB ¹ NB ²	1 TH-RT 1 LT, 1 TH 1 LT-RT	- A (8.1) C (16.2)	N/A	- A (8.2) B (12.9)	N/A
‘Build’ (2028) Conditions	EB ¹ WB ¹ NB ² SB ²	1 LT-TH-RT 1 LT, 1 TH-RT 1 LT-TH-RT 1 LT, 1 TH-RT	A (8.4) A (8.2) D (27.7) C (22.6)	N/A	A (8.3) A (8.5) C (20.2) C (21.5)	N/A

1. Level of service for major street left turn movement.
2. Level of service for minor stop-controlled approach.

Bold denotes lane reconfiguration and/or improvement to be provided by developer.

Capacity analysis indicates the major street left turn movements [on Butler Bridge Road] are expected to operate at LOS A during the weekday AM and PM peak hours under all existing and future traffic conditions. Additionally, the minor stop-controlled approaches [of Haw River Road and Site Drive 1] are expected to operate at an overall LOS D or better. While the need for mitigation improvements should be addressed if the level of service degrades by at least one level, no mitigation was identified considering the delays on the side-street approaches are not expected to increase by more than 11.5 seconds per vehicle and are

expected to operate at acceptable levels of service. Even though it is not striped, the northbound approach of Haw River Road is wide enough to accommodate side-by-side stacking of left and right turning vehicles, which could improve levels of operation by separating the left and right turning movements.

7.7. Butler Bridge Road and Yadkin Road

The existing unsignalized intersection of Butler Bridge Road and Yadkin Road was analyzed under existing, 'no-build', and 'build' traffic conditions with existing lane configurations and traffic control. Refer to Table 12 for a summary of the analysis results. Refer to Appendix K for the Synchro capacity analysis reports.

Table 12: Analysis Summary of Butler Bridge Road and Yadkin Road

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	EB WB ¹ NB ²	1 TH-RT 1 LT, 1 TH 1 LT-RT	- A (8.1) B (10.1)	N/A	- A (8.2) A (9.8)	N/A
'No-Build' (2028) Conditions	EB WB ¹ NB ²	1 TH-RT 1 LT, 1 TH 1 LT-RT	- A (8.2) B (10.5)	N/A	- A (8.3) B (10.1)	N/A
'Build' (2028) Conditions	EB WB ¹ NB ²	1 TH-RT 1 LT, 1 TH 1 LT-RT	- A (8.9) B (13.1)	N/A	- A (8.8) B (11.3)	N/A

1. Level of service for major street left turn movement.
2. Level of service for minor stop-controlled approach.

Capacity analysis indicates the major street left turn movement [on Butler Bridge Road] is expected to operate at LOS A during the weekday AM and PM peak hours under all existing and future traffic conditions. Additionally, the minor stop-controlled approach [of Yadkin Road] is expected to operate at an overall LOS B or better.

7.8. Butler Bridge Road and North Rugby Road

The existing unsignalized intersection of Butler Bridge Road and North Rugby Road was analyzed under existing, ‘no-build’, and ‘build’ traffic conditions with existing lane configurations and traffic control in addition to the improvements associated with the NCDOT STIP project [under all future traffic conditions]. Refer to Table 13 for a summary of the analysis results. Refer to Appendix L for the Synchro capacity analysis reports.

Table 13: Analysis Summary of Butler Bridge Road and North Rugby Road

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
Existing (2018) Conditions	EB WB ¹ NB ²	1 TH-RT 1 LT-TH 1 LT-RT	- A (8.8) C (19.7)	N/A	- A (9.1) B (12.4)	N/A
‘No-Build’ (2028) Conditions [Signalized]	EB WB NB	1 TH-RT 1 LT, 1 TH 1 LT, 1 RT	C (20.8) B (11.2) C (29.1)	B (19.9)	B (17.3) B (19.7) C (27.5)	C (20.7)
‘Build’ (2028) Conditions	EB WB NB	1 TH-RT 1 LT-TH 1 LT-RT	C (24.4) B (11.8) C (34.2)	C (22.7)	C (21.0) B (17.7) C (27.5)	C (20.5)

1. Level of service for major street left turn movement.
 2. Level of service for minor stop-controlled approach.
- Bold denotes improvements to be provided under NCDOT STIP I-4400C.**

Capacity analysis indicates the major street left turn movement [on Butler Bridge Road] operates at LOS A during the weekday AM and PM peak hours under existing traffic conditions. Additionally, the minor stop-controlled approach [of North Rugby Road] operates at LOS C or better.

With the installation of a traffic signal under NCDOT STIP I-4400C, capacity analysis indicates that the intersection is expected to operate at an overall LOS C or better during the weekday AM and PM peak hours under all future traffic conditions. In addition, all intersection approaches are expected to operate at LOS C or better. While the need for mitigation improvements should be addressed if the level of service degrades by at least one

level, no mitigation was identified considering the overall intersection and approach delays are not expected to increase by more than 4.0 seconds per vehicle and are expected to operate at acceptable levels of service.

7.9. Butler Bridge Road and Site Drive 2

The proposed unsignalized intersection of Butler Bridge Road and Site Drive 2 was analyzed under ‘build’ traffic conditions with proposed lane configurations and traffic control. Based on the future ‘build’ traffic volumes, an eastbound exclusive left turn lane and an exclusive westbound right turn lane are warranted on Butler Bridge Road. Refer to Table 14 for a summary of the analysis results. Refer to Appendix M for the Synchro capacity analysis reports, and Appendix N for the NCDOT turn lane warrant charts with the future ‘build’ traffic volumes charted.

Table 14: Analysis Summary of Butler Bridge Road and Site Drive 2

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
‘Build’ (2028) Conditions	EB ¹ WB SB ²	1 LT, 1 TH 1 TH, 1 RT 1 LT, 1 RT	A (8.4) - D (27.4)	N/A	A (9.1) - D (25.1)	N/A

- 1. Level of service for major street left turn movement.
- 2. Level of service for minor stop-controlled approach.

Bold denotes lane reconfiguration and/or improvement to be provided by developer.

With NCDOT warranted turn lanes provided on the eastbound [left] and westbound [right] approaches [on Butler Bridge Road], the major street left turn movement is expected to operate at LOS A during the weekday AM and PM peak hours under future ‘build’ traffic conditions. Additionally, the minor stop-controlled approach [of Site Drive 2] is expected to operate at LOS D.

8. CONCLUSIONS

This Traffic Impact Analysis was conducted to determine the potential traffic impacts of the proposed Tap Root Farms residential development with 472 single-family homes and 227 townhomes. The proposed development is located on the north side of Butler Bridge Road west of I-26 in Henderson County, North Carolina and is expected to be built out by 2028. Full movement access is to be provided via two (2) new driveway connection on Butler Bridge Road, with one located opposite Haw River Road and the other located approximately 650 feet [measured center-to-center] west of Yadkin Road.

The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- Existing (2018) Traffic Conditions
- Future (2028) 'No-Build' Traffic Conditions
- Future (2028) 'Build' Traffic Conditions
- Future (2028) 'Build' Traffic Conditions with Improvements

Trip Generation

It is estimated that the proposed development will generate approximately 6,010 total trips during a typical 24-hour weekday period. Of the daily traffic volume, it is anticipated 444 trips (109 entering and 335 exiting) will occur during the AM peak hour and 573 trips (361 entering and 212 exiting) will occur during the PM peak hour.

Adjustments to Analysis Guidelines

Capacity analysis at all study intersections was completed according to NCDOT Congestion Management Guidelines.

Intersection Capacity Analysis Summary

All study area intersections (including the proposed site driveways) are expected to operate at acceptable levels of service under future 'build' traffic conditions, or similar levels when compared to 'no-build' conditions.

Queuing Analysis Summary

In addition to the capacity analysis, a queuing analysis was performed utilizing SimTraffic to develop traffic simulation models for the weekday AM and PM peak hours under future 'no-build' and 'build' traffic conditions. Based on a review of the maximum queuing results that are based on an average of ten (10) traffic simulation runs, and the 95th percentile queues calculated by Synchro, the [highest between the two] projected queues are not expected to extend back into adjacent intersections. Additionally, the projected queues are expected to be accommodated by existing and proposed turn lane storage lengths, except for the eastbound right turn lane on Butler Bridge Road at US 25 during the AM peak hour. Although the queue could potentially exceed the proposed storage [to be provided under STIP I-4400C] on occasion, the location of the bridge over I-26 prohibits the ability to provide any additional storage. No right turns were permitted at any signalized intersection for the purpose of this analysis; therefore, improved operations and decreased queues could be expected. Refer to Appendix O for more detailed SimTraffic queuing analysis reports.

9. RECOMMENDATIONS

Based on the findings of this study, specific geometric improvements have been identified and are recommended to accommodate future traffic conditions. See a more detailed description of the recommended improvements below. Refer to Figure 9 for an illustration of the proposed geometrics and traffic control.

Recommended Improvements by Developer

US 25 and Butler Bridge Road

- Restripe the outbound lane on Butler Bridge Road [that drops as a left turn lane at North Rugby Road] to provide a second exclusive left turn lane at US 25. Maximize the storage and taper to provide equal storage for the back-to-back left turns between US 25 and North Rugby Road.

Butler Bridge Road and Haw River Road/Site Drive 1

- Provide a three-lane cross-section [for Site Drive 1] consisting of one ingress and two egress lanes. Stripe the egress to provide a shared left-through lane and an exclusive right turn lane. Per NCDOT's "Policy on Street and Driveway Access to North Carolina Highways", "a minimum storage of 100 feet measured from the near edge of the right-of-way will be required before any crossing or left-turning conflicts are allowed".

Butler Bridge Road and Site Drive 2

- Construct an exclusive left turn lane on the eastbound approach [of Butler Bridge Road]. Provide a minimum of 100 feet of full storage and appropriate taper lengths.
- Construct an exclusive westbound right turn lane on the westbound approach [of Butler Bridge Road]. Provide a minimum of 100 feet of full storage and appropriate taper lengths.
- Provide a three-lane cross-section [for Site Drive 2] consisting of one ingress and two egress lanes. Stripe the egress to provide exclusive left and right turn lanes. Per NCDOT's "Policy on Street and Driveway Access to North Carolina Highways", "a minimum storage of 100 feet measured from the near edge of the right-of-way will be required before any crossing or left-turning conflicts are allowed".