LINCOLN COUNTY PLANNING & INSPECTIONS DEPARTMENT
302 NORTH ACADEMY STREET, SUITE A, LINCOLNTON, NORTH CAROLINA 28092
704-736-8440 OFFICE 704-736-8434 INSPECTION REQUEST LINE 704-732-9010 FAX

To: Board of Commissioners
Planning Board

From: Randy Hawkins, Zoning Administrator

Date: October 21, 2016

Re: PD #2016-5
Hawthorne Development Group, LLC, applicant
Parcel ID# 32848, 32850 and 89714

The following information is for use by the Lincoln County Board of Commissioners and Planning Board at their joint meeting/public hearing on November 7, 2016.

REQUEST

The applicant is requesting the rezoning of 73 acres from R-T (Transitional Residential) and R-SF (Residential Single-Family) to PD-R (Planned Development-Residential) to permit a subdivision with up to 180 single-family detached homes. Under the Lincoln County Unified Development Ordinance, any proposed subdivision with 50 or more lots is subject to approval through the planned development process. The applicant is also proposing lots smaller in size than the minimum area permitted in the R-T and R-SF districts.

A concept plan and guidelines for the proposed development, Brookdale, have been submitted as part of the rezoning application and would serve as the master plan for the development if the rezoning request is approved. A traffic impact analysis has also been submitted.

SITE AREA AND DESCRIPTION

The property borders Triangle Circle, Rufus Road and Airlie Parkway in Catawba Springs Township. It is adjoined by property zoned R-T, R-SF, PD-MU (Planned Development Mixed Use) and I-G (General Industrial). Land uses in the area include residential, business and industrial.

This property is adjacent to the site of the planned Rivercross mixed-use development. One of the accesses to Brookdale would be via a connection to Rivercross and its planned entrance off Triangle Circle. Other access points would be located on Rufus Road and Airlie Parkway.

Airlie Business Park is located to the west of this property on the opposite side of Airlie Parkway, and a potential future phase of the business park is located to the south.

Brookdale would be served by county water and sewer. Existing lines are located in this area.

A stream and a Duke Energy transmission right-of-way cross the eastern portion of this property. A stream also impacts the western portion of the property to a lesser degree.

This property is not located in a water-supply watershed. No portion of this property is located in a 100-year floodplain.

PLAN CONFORMANCE

This property is part of an area designated by the Lincoln County Land Use Plan for future industrial development. However, its industrial potential is limited by the streams and other site constraints, according to the Lincoln Economic Development Association (see following page).

The NC 16 Corridor Vision Plan calls for a new road network in this area that would provide alternate travel routes between N.C. 16 Business and Optimist Club Road, Rufus Road and Triangle Circle. In combination with the planned Rivercross development, this proposed development would accomplish that goal.

UDO COMPLIANCE

The UDO requires that a planned development include a minimum of 12.5% recreation and open space. Approximately 25% of the acreage in Brookdale would be reserved as recreation and open space.

The proposed plan also complies with the UDO's subdivision standards for external access, internal connectivity, block length and cul-de-sac length.

As a condition of rezoning, Section 9.8.7 of the UDO requires a developer to provide road improvements to maintain the service level of any/all legs of an intersection if it would be lowered by a proposed development. The traffic impact analysis for the Brookdale development shows it would lower the service level of two legs of the N.C. 16 Bypass/Optimist Club Road intersection in the a.m. peak hours. Staff has asked the applicant to propose improvements to maintain the service level or to provide a thorough explanation of why the developer shouldn't be required to do so. The information had not been received at the time of this report.

STAFF'S RECOMMENDATION

Provided the traffic impact issue is satisfactorily addressed, staff recommends that the rezoning request be approved. See staff's proposed statement of consistency and reasonableness for rationale.

Randy Hawkins

From: Cliff <cliff@lincolneda.org>
Sent: Wednesday, August 17, 2016 3:08 PM
To: Randy Hawkins
Cc: Andrew Bryant
Subject: Parcels 32848, 32850, 89714

Mr. Hawkins,

Thank you for contacting LEDA regarding Parcels 32848, 32850 and 89714 and the potential residential development there. This property is adjacent to Airlie Business Park, and is shown as industrial on the County's area use plans. However, due to the topography's challenges including not one but two needed stream buffers, a Duke Power utility easement, and the size of the building pads that could be drawn on the sites this property is limited for attractive industrial investment. In order to utilize the property, it would also have to be purchased, adding to the existing cost of Airlie's development. Improving the land for a total investment including purchasing it would make for sites that are priced above what the market would carry.

As I have stated recently in acknowledging LEDA's intentions not to hold back development of sites previously designated for industrial purposes, we definitely do see the need for larger spaces for industrial development. However, we need sizeable tracts unencumbered by topographical constraints that, in order to cure, would necessitate cost that would make such sites unattractive in the marketplace. That being said, I see no reason to keep the subject parcels planned for industrial use.

Sincerely,

Cliff Brumfield
Executive Director
Lincoln Economic Development Association
502 East Main Street
Lincolnton, NC 28092

cliff@lincolneda.org
(704) 577-9620 Cell
(704) 732-1511 Ext. 4

PD 2016-5 (Brookdale) Capacity Statement

Public Schools

The proposed development of 180 single-family lots is in the St. James Elementary, East Lincoln Middle and East Lincoln High districts. Based on current student generation rates, the development is projected to produce approximately 59 students spread over the K-12 system. *Per the county's Adequate Public Facilities Ordinance and its associated Memorandums of Understanding, the associated schools and the system in general have the capacity to handle the proposed development.

Water and Sewer

The water system and sewer system are both believed to have adequate capacity to serve the proposed development. It is the Petitioner's responsibility to incur all permit fees, availability fees, and infrastructure costs for providing the water and sewer throughout the project for all buildings. All infrastructure must meet the state of North Carolina's and Lincoln County's construction standards. The Petitioner understands that water and sewer availability must be approved by Lincoln County prior to development.

*All of the proposed residential developments up for rezoning hearings on November 7 were included in the modeling.

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Zoning Amendment
Staff's Proposed Statement of Consistency and Reasonableness

Case No. **PD #2016-5**

Applicant **Hawthorne Development Group, LLC**

Parcel ID# **73 acres**

Location **bordering Triangle Circle, Rufus Road and Airlie Parkway**

Proposed amendment **rezone from R-T and R-SF to PD-R to permit a subdivision with up to 180 lots for single-family detached homes**

This proposed amendment **is not consistent** with the Lincoln County Comprehensive Land Use Plan and other adopted plans in that:

This property is located in an area designated by the Land Use Plan for future industrial development.

This proposed amendment **is reasonable and in the public interest** in that:

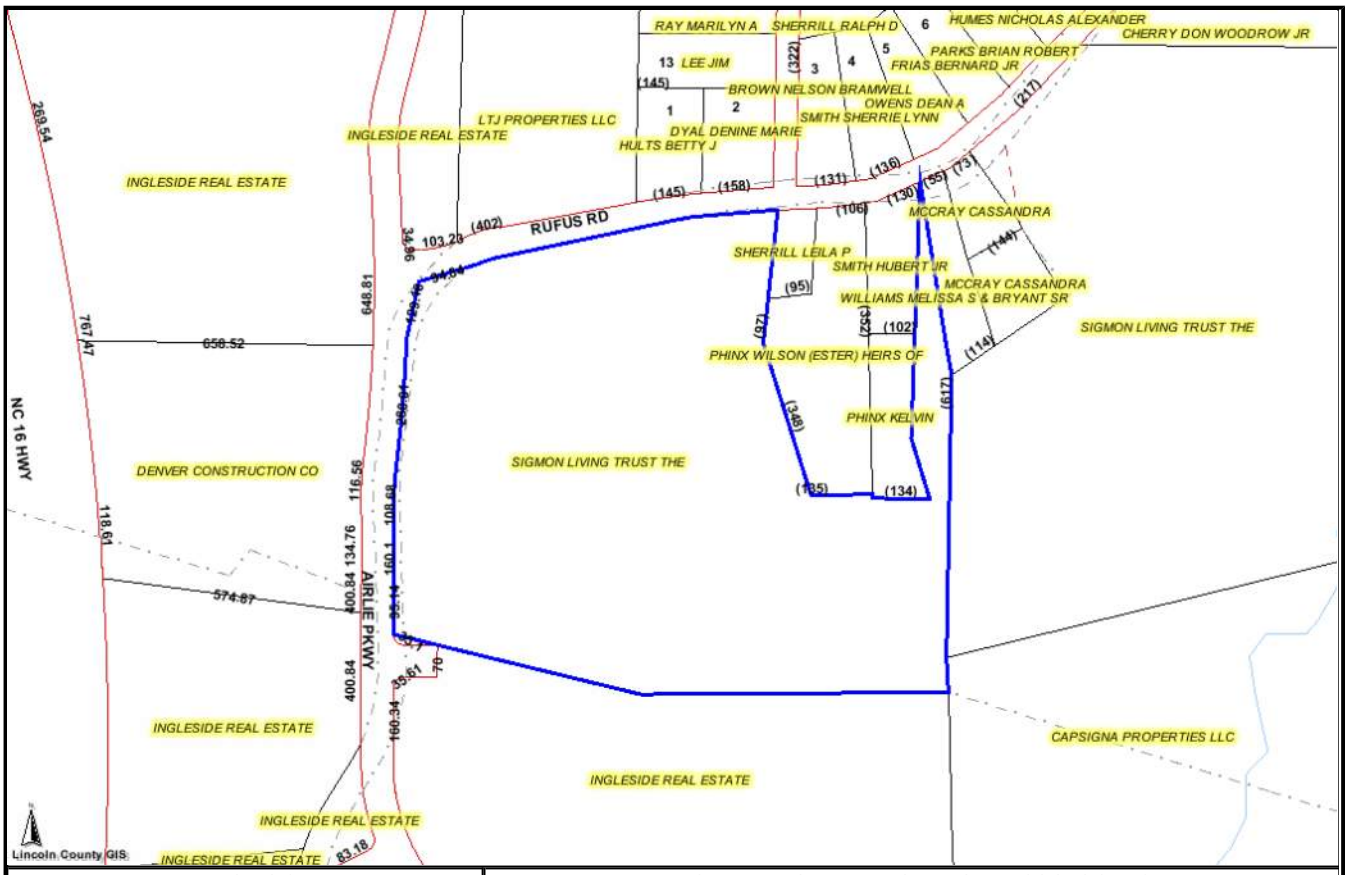
This property is located adjacent to an existing residential area and adjacent to a planned residential area that's part of an approved mixed-use development. The industrial potential of this property is limited by site constraints. In conjunction with the planned Rivercross development, this development would accomplish a goal of the NC Corridor Vision Plan: a new road network to provide alternate travel routes between N.C. 16 Business and Optimist Club Road, Rufus Road and Triangle Circle. The plans for this subdivision meet all of the requirements of the Unified Development Ordinance. Approximately 25% of the property will be set aside as recreation and open space. Amenities will be provided as part of the master plan.

Lincoln County, NC

Office of the Tax Administrator, GIS Mapping Division

Lincoln County and its mapping contractors assume no legal responsibility for the information contained on this map. This map is not to be used for land conveyance. The map is based on NC State Plane Coordinate System 1983 NAD.

Date: 9/7/2016 Scale: 1 Inch = 400 Feet



PHOTOS

PARCEL INFORMATION FOR 4603-30-1845

Parcel ID	**32848**	**Owner**	SIGMON LIVING TRUST THE FOX CATHERINE NIXON NIXON JAMES ARTHUR		
Map	**4603-00**	**Mailing**	4849 BURRIS RD		
Account	0221746	**Address**	DENVER NC 28037		
Deed	2146-214	**Recorded**	9/4/2009	**Sale Price**	0
Land Value	$223,102	**Total Value**	$223,102	**Previous Parcel**	
	----- All values are for tax year 2016. -----				
Description	W PHINIX LD RD 1387			**Deed Acres**	0
Address	A C SHERRILL RD			**Tax Acres**	22.59
Township	CATAWBA SPRINGS		**Tax/Fire District**	EAST LINCOLN	
Improvement			No Improvements		

Zoning	**Calculated**	**Voting Precinct**	**Calculated Acres**
District	**Acres**	TRIANGLE (TR30)	22.59
R-T	22.59		
Watershed Class		**Sewer District**	
Not in a watershed	22.59	Not in the sewer district	22.59

2000 Census County	**Tract**	**Block**	
37109	071100	2015	0.59
37109	071100	2016	22

Flood	**Zone Description**	**Panel**	
X	NO FLOOD HAZARD	3710460300	22.59

Lincoln County, NC

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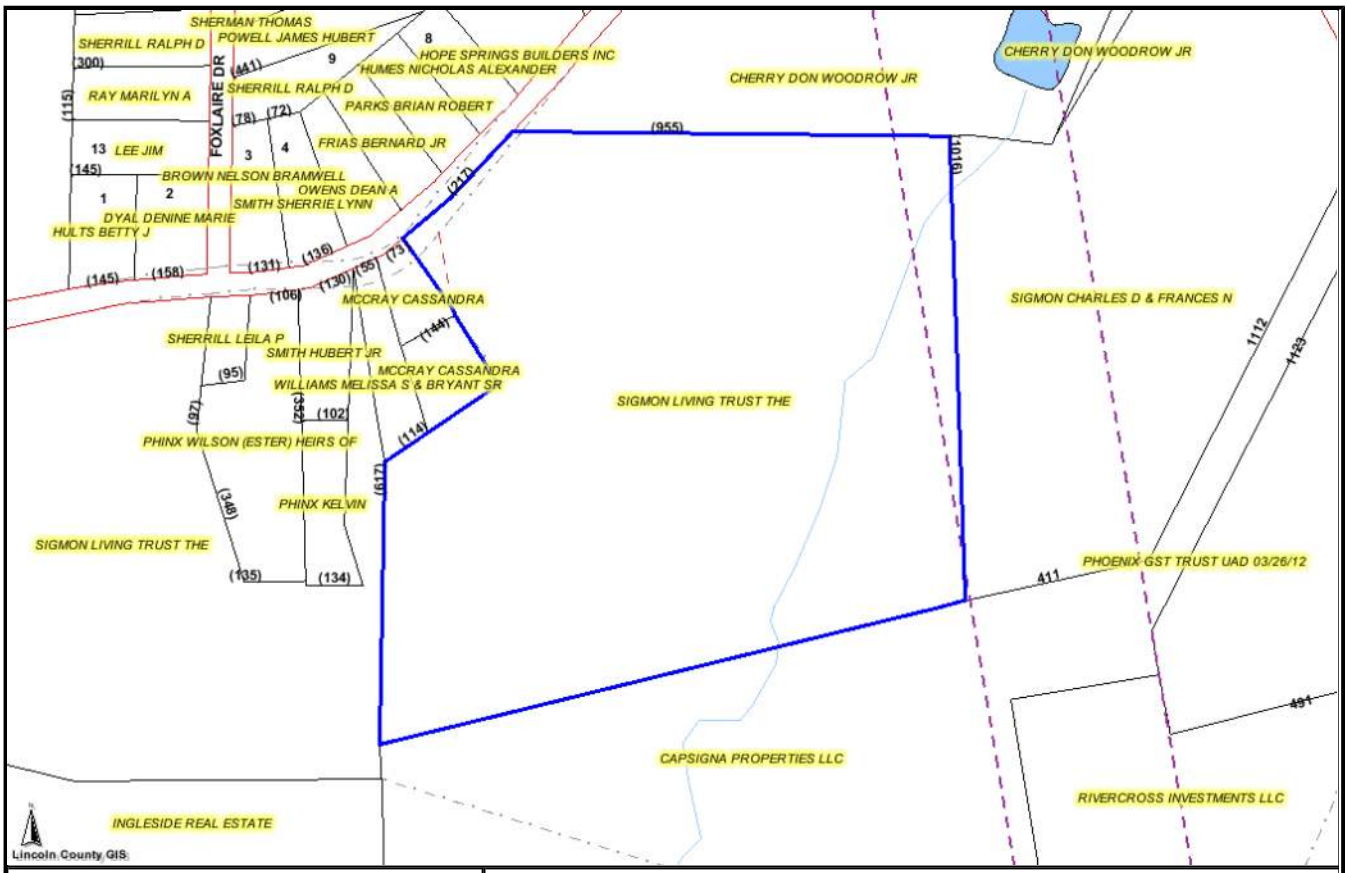
Date: 9/7/2016 Scale: 1 Inch = 400 Feet



PHOTOS	PARCEL INFORMATION FOR 4603-41-3093					
Photo Not Available	**Parcel ID**	**32850**	**Owner**	SIGMON LIVING TRUST THE FOX CATHERINE NIXON NIXON JAMES ARTHUR		
	Map	**4603-00**	**Mailing**	4849 BURRIS RD		
	Account	0221746	**Address**	DENVER NC 28037		
	Deed	2159-642	**Recorded**	11/13/2009	**Sale Price**	0
	Land Value	$278,551	**Total Value**	$278,551	**Previous Parcel**	
	----- All values are for tax year 2016. -----					
	Description	CLARK LAND RD 1387			**Deed Acres**	31
	Address	RUFUS RD			**Tax Acres**	31.52
	Township	CATAWBA SPRINGS		**Tax/Fire District**	EAST LINCOLN	
	Improvement	No Improvements				

Zoning District	Calculated Acres	Voting Precinct	Calculated Acres
R-T	30.02	TRIANGLE (TR30)	31.52
R-SF	1.5		

Watershed Class		Sewer District	
Not in a watershed	31.52	Not in the sewer district	31.52

2000 Census County	Tract	Block	
37109	071100	2015	0.08
37109	071100	2016	31.44

Flood	Zone Description	Panel	
X	NO FLOOD HAZARD	3710460300	31.52

Lincoln County, NC

Office of the Tax Administrator, GIS Mapping Division

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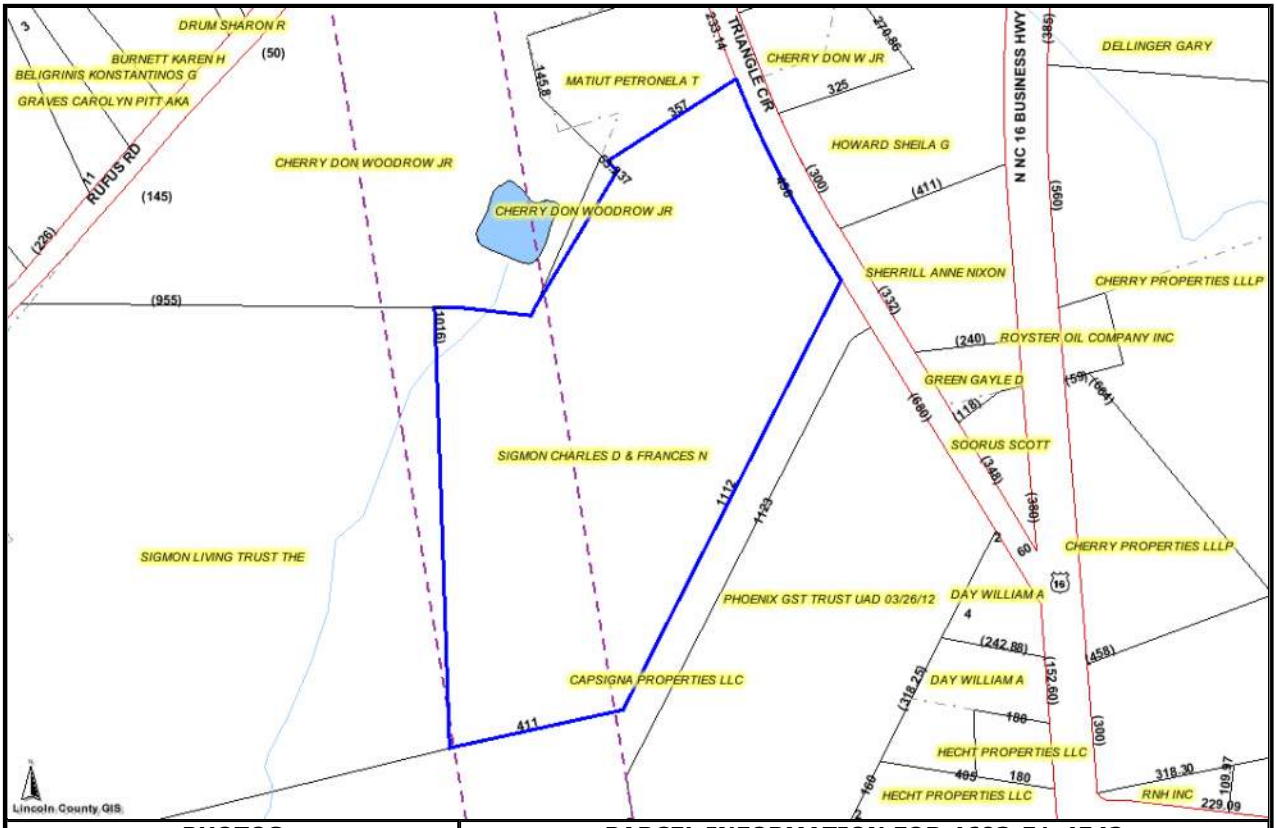


PHOTOS

Photo Not Available

PARCEL INFORMATION FOR 4603-51-4542

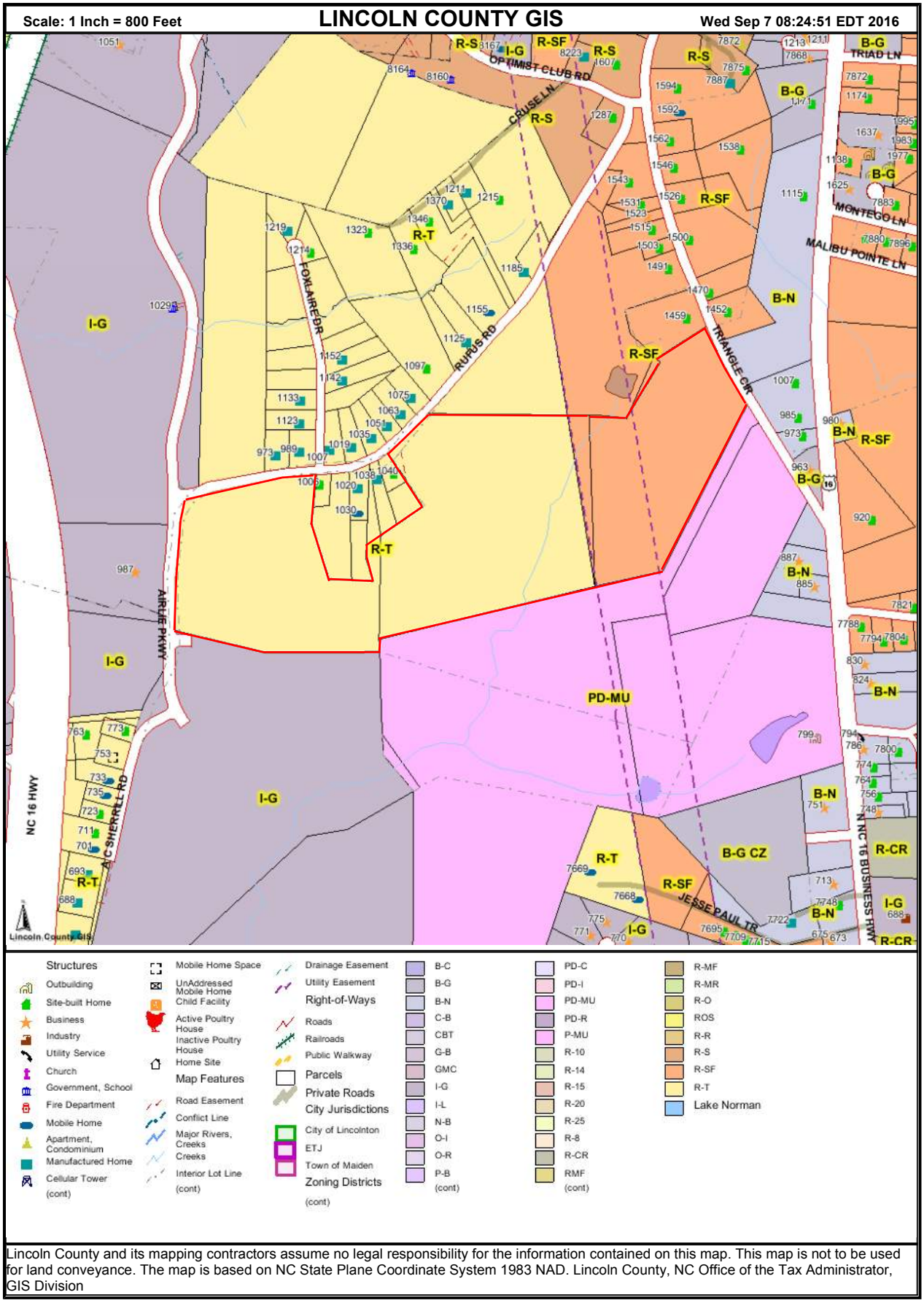
Parcel ID	**60335**	**Owner**	SIGMON CHARLES D & FRANCES N CO TRUSTEE SIGMON LIVING TRUST FOX CATHERINE NIXON & JAMES A		
Map	**4603-19**	**Mailing**	4849 BURRIS RD		
Account	0223513	**Address**	DENVER NC 28037		
Deed	2164-866	**Recorded**	12/14/2009	**Sale Price**	0
Land Value	$130,858	**Total Value**	$130,858	**Previous Parcel**	60090
			----- All values are for tax year 2016. -----		
Description	PT OF SIGMON LAND			**Deed Acres**	21
Address	TRIANGLE CIR			**Tax Acres**	15.17
Township	CATAWBA SPRINGS		**Tax/Fire District**	EAST LINCOLN	
Improvement			No Improvements		

Parcel ID	**89714**	**Owner**	SIGMON CHARLES D & FRANCES N CO TRUSTEE SIGMON LIVING TRUST FOX CATHERINE NIXON & JAMES A		
Map	**4603-19**	**Mailing**	4849 BURRIS RD		
Account	0223513	**Address**	DENVER NC 28037		
Deed	2164-866	**Recorded**	12/14/2009	**Sale Price**	0
Land Value	$35,655	**Total Value**	$35,655	**Previous Parcel**	32847
			----- All values are for tax year 2016. -----		
Description	PT OF SIGMON LAND			**Deed Acres**	21
Address	TRIANGLE CIR			**Tax Acres**	4.13
Township	CATAWBA SPRINGS		**Tax/Fire District**	EAST LINCOLN / EL SEWER	
Improvement			No Improvements		

Zoning	**Calculated**	**Voting Precinct**	**Calculated Acres**
District	**Acres**	TRIANGLE (TR30)	19.31
R-SF	19.31		
Watershed Class		**Sewer District**	
Not in a watershed	18.47	Not in the sewer district	15.17
WS-IVC	0.84	In the sewer District	4.13

2000 Census County		**Tract**	**Block**	
37109		071100	2016	19.31
Flood	**Zone Description**	**Panel**		
X	NO FLOOD HAZARD	3710460300		19.31

PD #2016-5
Subject property is outlined in red



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Planned Development Rezoning Application

Lincoln County Planning and Inspections Department
Zoning Administrator
302 N. Academy St., Lincolnton, NC 28092
Phone: (704)736-8440 Fax: (704)732-9010

PART I

Applicant Name: Hawthorne Development Group

Applicant Address: 11220 Elm Lane, Suite 200, Charlotte, NC 28277

Applicant Phone Number: 704-607-5059

Property Owner Name: Charles & Frances Sigmon for The Sigmon Living Trust

Property Owner Address: 4849 Burris Rd, Denver, NC 28037

Property Owner Phone Number: _____

PART II

Property Location: Rufus Road, Denver, NC

Property ID (10 digits): 4603-30-1845, 4603-41-3093 4603-51-4542 Property size: 73.5 Acres

Parcel # (5 digits): 32850, 32848 89714 Deed Book(s): 2159/642, 5146/214, 2164/866 Page(s): _____

PART III

Existing Zoning District: R-SF Proposed Zoning District: PD-R

Briefly describe how the property is being used and any existing structures.

Mostly wooded with some farm fields.

Briefly described the proposed planned development.

180 lot single-family subdivision

***SEE PLANNING DEPT. FOR PLANNED DEVELOPMENT FEES.**

I hereby certify that all knowledge of the information provided for this application and attachments is true and correct to the best of my knowledge.

Applicant's Signature 8-18-16 Date

Brookdale Neighborhood Meeting Minutes

7pm, 10.4.2016
East Lincoln Community Center

Robert Davis welcomed those attending, introduced elected & appointed officials, County staff, Steve Bailey of Hawthorne Dev. Group, and himself. Steven Bailey presented a 15-minute slideshow describing the proposed subdivision layout, proposed home elevations, and traffic study findings.

Steven Bailey and Robert Davis then answered and discussed the following concerns raised by the audience:

1. Traffic at the HWY 16/Optimist Club Road intersection was a concern. Mr. Davis stated that NCDOT is working on a plan to improve the intersection by lengthening the turn lanes on HWY 16.
2. Mr. Walter Fields questioned the timing of the proposed developer's contribution for the Business /Triangle Circle intersection. He also questioned the conclusions from the traffic study.
3. Mr. Walter Fields questioned how we distributed the traffic from the Brookdale development.
4. Several neighbors raised a general concern about traffic from the growing number of developments in the area.
5. A neighbor questioned the school capacity for Brookdale and the other developments being proposed in the area. Randy Hawkins stated there is a proposed school site being donated in the general vicinity of Brookdale. Commissioner Martin Oakes said he had spent a great deal of time studying the existing developments in the area to determine the actual number of students per house in each. Neighborhoods in the area were generating 0.3 students per house. Attendance in Lincoln County Schools has actually been decreasing the last few years.
6. A neighbor asked about the phasing and anticipated timeline of the development. Steven Bailey stated they expected to start building houses in late 2017 and complete the development in 2020.
7. A neighbor asked about the size and price point of the homes. Steven Bailey answered that the house will be between 1,800-4,000 square feet and the price would be market-driven, but anticipated to be in the $250k-$400k range.
8. A neighbor asked about how traffic studies from multiple proposed developments are coordinated when the developments are in the same area. Steven Bailey explained that each TIA applies a growth factor to account for other developments. Robert Davis added that the same NCDOT District Engineer is reviewing all of the traffic studies for this region.

The presentation ended around 8pm. Steven Bailey and Robert Davis stayed to continue discussions with individual neighbors for about 30 minutes. According to the sign-in sheet, 26 neighbors attended.

PD-R CONDITIONS
BROOKDALE
AIRLIE ROAD, LINCOLN COUNTY, NC

1. PROJECT INFORMATION

Brookdale is a proposed single family residential community with detached homes on an approximately 73 acre site located on the south side of Rufus Road. The property includes three tracts of land comprised of Property Identification Nos. 4603514542, 4603413093, 4603301845. The proposed development will include up to 180 single family lots.

Access to the site will be from Airlie Pkwy, Rufus Road, and from the proposed entrance road along the Rivercross Apartment site. Land uses surrounding the site include single family residential. A PD-R Plan with vicinity map is included for reference.

A key feature of the proposed community will be the ample open space. A minimum of 25% of the site will be left undeveloped as natural buffer area and/or passive and active open space. An existing stream bisects the property.

Homes within the community will be offered for sale. Homes may range in size from approximately 2,000 square feet to approximately 3,500 square feet as dictated by the consumer or demand.

The property is currently zoned R-SF and R-T. Proposed zoning is PD-R. The property is not located in a water supply watershed.

2. GENERAL PROVISIONS

The PD-R Plan is intended to reflect a generalized arrangement of the site in terms of lot layout, street network, and open space areas. Final lot configuration, placement and size of individual site elements, streets alignments, etc. may be altered or modified within the limits of the Ordinance as described in Section 9.5.13, and the standards established within these conditional notes during the design development (platting) and construction phases. The Petitioner reserves the right to make minor modifications and adjustments to the approved PD-R Plan, including minor reconfiguring lots and street layouts, subject to staff approval, provided that the total number of residential units does not exceed the maximum permitted. Any major modifications will require resubmittal to the Board of Commissioners.

3. DEVELOPMENT STANDARDS

Pursuant to Sections 2.4.9 and 9.5 of the Lincoln County Unified Development Ordinance entitled Planned Development Districts and Planned Development Review respectively; the Petitioner seeks to obtain approval of the use of the following Development Standards concurrently with the approval of the Rezoning Petition. These standards, as established both by the conditional notes as set out below and as depicted on the Preliminary Concept Plan shall be followed for

development of the property. Unless otherwise approved as part of these conditional notes, the Lincoln County Unified Development Ordinance shall prevail when developing the site.

A. PERMITTED USES

1) The project shall be limited to 180 detached single family residential dwellings and any incidental or accessory uses.
2) Uses on the Common Open Space (COS) may include landscaping, fences, walls, berms, pedestrian trails, recreational uses, entry signage, monuments, and storm water BMPs (if required).

B. DENSITY

Gross residential density for the project will not exceed 2.6 units per acre. Open space areas shall be included in the calculations for gross residential density.

C. LOT STANDARDS

The proposed development includes a 20-foot perimeter buffer. Residential lots will have the following setbacks:

Front Setback:	10 feet (20 feet to garage)
Side Setback:	5 feet (10 feet for corner lots)
Rear Setback :	10 feet

Building height shall be limited to 35 feet. Lot platting will meet Lincoln County subdivision regulations.

D. GENERAL SITE DESIGN

The following items will be offered as part of this development:

1) Streets within the subdivision shall be designed per NCDOT standards. Roadways will be dedicated to NCDOT for maintenance once density requirements are met.
2) All fencing shall be consistent in nature and subject to review and approval by the property management association and shall respect all sight triangles. Front yard fencing is prohibited. Rear and side yard fencing, including fencing on corner lots, shall not exceed 6’ in height. Fence materials may include wood, metal, or decorative PVC.

3) The project will contain the following amenity features. These proposed amenity areas will be installed concurrently with the lots immediately surrounding them.
    a. Sidewalks along all proposed streets
    b. Picnic area with tables and/or benches
    c. Child play equipment (Tot Lot)
    d. Landscape areas
    e. Enhanced entry
    f. A signage plan shall be submitted for the development at the time construction drawings are prepared for the first section of the development. All signage shall conform to standards of the Lincoln County Unified Development Ordinance. Signage shall be monument style and shall complement the architectural characteristics of the neighborhood.
4) Canopy street trees shall be placed at 40 feet on center along both sides of the proposed streets. Any existing trees in excess of 6 caliper inches within 20 feet of the right of way shall be credited for one required tree to be planted. Duke Energy right-of-way, intersection sight triangles, and proposed driveway locations may vary the placement of street trees.
5) Decorative lighting shall be used through the project.
6) Mail box kiosks locations will be reviewed by the Postmaster.
7) Dry utilities for telephone, cable TV, electricity, and natural gas will be provided by local utility companies. Utilities within the community shall be placed underground. The main feed lines and transformers from the main road may be located above ground.
8) Garbage collection will be provided by a private service and included in homeowner association dues.
9) Open Space
    a. The project will offer over 25+/-% of common open space. Common open space will be provided as generally depicted on the PD-R Plan.
    b. A portion of the open space will be active open space.
    c. The project will offer a 20-foot Class B perimeter buffers as depicted on the Preliminary Development Concept Plan.

E. STORMWATER COMPLIANCE

The development will be subject to Lincoln County's storm water management regulations in place at the time of preliminary plat submittal. Storm water BMPs will be incorporated into

the design if required by stream crossing permits (401/404). Stream buffers shall be provided along all jurisdictional streams in accordance with NCDENR and Lincoln County requirements.

F. ESTABLISHMENT OF A PROPERTY ASSOCIATION

A Property Management Association shall be established and will be responsible for maintaining all rights-of-way landscaping, signs, amenity features, storm water BMPs (if required), and common open space areas. The documents covering the structure of the association shall be filed with the recorded final plat.

G. RESTRICTIVE COVENANTS

Restrictive Covenants will be created and recorded prior to final plat recordation, to establish, among other items, permitted uses and maintenance responsibility of the property management association. Restrictive covenants will include language that ensures stream buffers, perimeter buffers, and setback areas are protected.

H. VEHICULAR ACCESS AND ROAD IMPROVEMENTS

1) Vehicular access:

   a. One access will be provided from Airlie Pkwy.

   b. One access will be provided from the entry road proposed by the Rivercross Apartments.

   c. Two connections to Rufus Road are proposed on the P-R Plan. Further evaluation to determine if both meet NCDOT's sight distance requirement will be done during the design phase.

2) Improvements to Existing Roads: A Traffic Impact Analysis (TIA) has been prepared for this project. Improvements required by the TIA are:

   a. Construct an Eastbound left turn with 50 feet of storage on South Triangle Circle at Business 16. In lieu of constructing this improvement, the developer will make a monetary contribution to the County for the amount equivalent to the construction cost, as calculated by NCDOT. This contribution, combined with other funds, will be used to study and improve traffic through and around this intersection. Payment shall be due 3 years after the first recorded plat or when the 101st lot is recorded, whichever comes first.

   b. The developer has also agreed to prepare a signal warrant analysis for the intersection of Airlie Parkway and Optimist Club Road.

I. CONSTRUCTION SCHEDULE AND PHASING

The development of the site will be completed in four phases as shown on the PD-R Plan.

J. MODEL HOMES/SALES OFFICES

Model homes may be constructed within residential areas at the developer's discretion. Mobile temporary sales offices shall be allowed at the developer's discretion and shall be subject to any special permits required by Lincoln County. All models shall have an approved all weather surface (stone, asphalt, etc.) prior to the issuance of a Certificate of Occupancy.

K. WATER AND SEWER AVAILABILITY

The property is within the Lincoln County Sewer District and Lincoln County Water District. The Petitioner understands that water and sewer availability must be approved by Lincoln County prior to development. It is the Petitioner's responsibility to incur all permit fees, availability fees, infrastructure costs for providing the water and sewer throughout the project for all buildings. The Petitioner will comply with all the County's water and sewer standards.

Based on discussions with Lincoln County Public Works, we believe there is adequate capacity in both sewer and water lines near the property.

L. APPLICABLE ORDINANCES

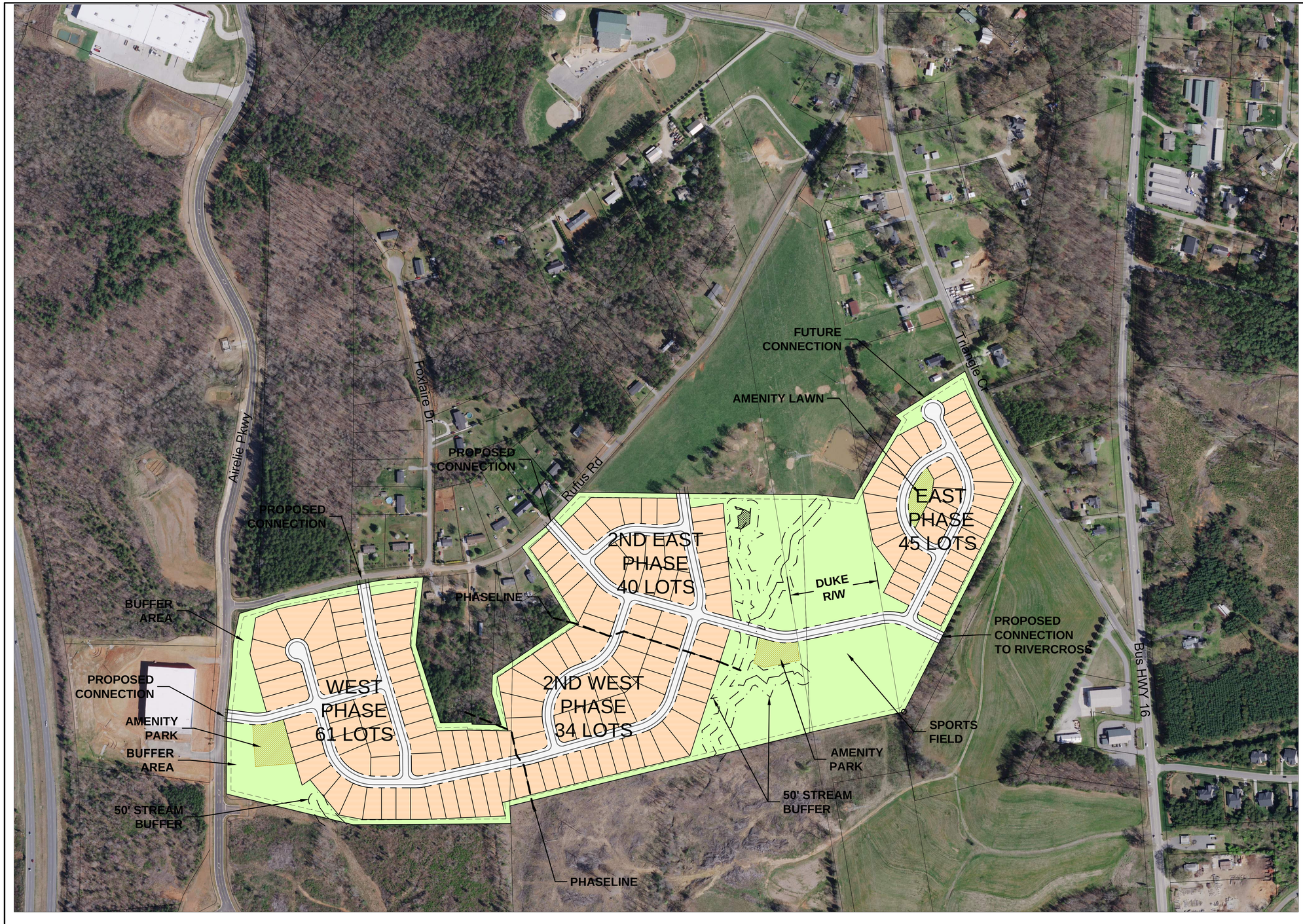
Development will be subject to the standards and requirements of the UDO in effect at the date of submission of the application for rezoning.

M. BINDING EFFECT

All conditions applicable to the development of the property approved with this rezoning, unless amended by the manner provided in the UDO, shall be binding to the Petitioner and subsequent owners of the Site and their assigns.

N. AMENDMENTS TO THE APPROVED CONDITIONAL DISTRICT PLAN

It is understood that the owner of the property must apply for any future amendments to the Development Standards, Conditional Notes and in accordance to the provisions of the UDO, Section 9.5.13.



Layout Data:

OWNER/DEVELOPER INFORMATION

RUFUS ROAD PARTNERS, LLC
11220 ELM LANE, SUITE 200
CHARLOTTE, NC 28277

PARCEL #'S: 4603514542, 4603413093, 4603301845

EXISTING ZONING: R-T and R-SF

PROPOSED ZONING: PD-R

WATERSHED: NONE

TOTAL AREA: 73+/- ACRES

TOTAL PROPOSED UNITS: 180 (2.5/ACRE)

MINIMUM LOT WIDTH: 50'

PROPOSED SETBACKS:

FRONT: 10' (20' TO GARAGE)

SIDE: 5'

REAR: 10'

OPEN SPACE:

REQUIRED: 12.5%

PROVIDED: 25%

SIDEWALKS SHALL BE PROVIDED ON ONE SIDE OF ALL PROPOSED STREETS.

CONNECTIVITY RATIO: 1.62

21 LINKS / 13 NODES

D R A F T

This Plan is Based on Preliminary Info

Brookdale

Rufus Road, Denver, NC

PD-R PLAN

Date: 10.6.2016

200 0 200 400

HORIZONTAL: 1"= 200'

BROOKDALE RESIDENTIAL DEVELOPMENT
LINCOLN COUNTY, NC

Traffic Impact Analysis
October 13, 2016

PREPARED BY:
Matthew Peach, PE, PTOE
A. Morton Thomas and Associates, Inc.
6131 Falls of Neuse Rd, Suite 106
Raleigh, NC 27609
919-855-9989

AMT Project File 16-0711.001
NC License No: F-1049

BROOKDALE RESIDENTIAL DEVELOPMENT

LINCOLN COUNTY, NC

Traffic Impact Analysis

October 13, 2016

PREPARED BY:
Matthew Peach, PE, PTOE
A. Morton Thomas and Associates, Inc.
6131 Falls of Neuse Rd, Suite 106
Raleigh, NC 27609
919-855-9989

AMT Project File 16-0711.001

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

EXECUTIVE SUMMARY

The proposed Brookdale Residential Development is located near the intersection of Rufus Road at Airlie Parkway in eastern Lincoln County, North Carolina. The development is proposed to consist of single family homes to be completed in 2019 with a total of 180 single family units.

This report summarizes the analyses of 2016 Existing conditions, 2019 No-Build conditions (without proposed development and with the Approved Adjacent Developments in place), 2019 Build conditions (with the proposed development in place), and 2019 Build Improved conditions (with proposed development and Recommended Improvements in place) during the AM and PM peak hours.

AMT (A. Morton Thomas and Associates, Inc.) was retained to determine the potential traffic impacts of this development in accordance with the traffic study guidelines set forth by Lincoln County and the North Carolina Department of Transportation (NCDOT) and the transportation improvements that may be required to accommodate these impacts. This report presents trip generation, distribution, capacity analyses, and recommendations for transportation improvements required to meet anticipated traffic demands.

As approved by Lincoln County and NCDOT, the following seven (7) intersections are included as part of the area of influence for the development.

- *NC 16 Bypass at Optimist Club Road* *(Unsignalized RCUT intersection)*
- *Optimist Club Road at Airlie Parkway* *(Unsignalized three-legged-intersection)*
- *Optimist Club Road at Rufus Road* *(Unsignalized three-legged-intersection)*
- *Optimist Club Road at Triangle Circle* *(Unsignalized three-legged-intersection)*
- *Rufus Road at Airlie Parkway* *(Unsignalized three-legged-intersection)*
- *NC 16 Business at Triangle Circle / Unity Church Road* *(Signalized four-legged-intersection)*
- *NC 16 Business at Triangle Circle (South Intersection)* *(Unsignalized three-legged-intersection)*

The following one (1) planned intersection are included in the study:

- *Triangle Circle at Rivercross Apartments Access* *(Unsignalized three-legged-intersection)*

The following four (4) proposed access points are included in the study:

- *Airlie Parkway at Site Access #1* *(Proposed)*
- *Rufus Road at Site Access #2* *(Proposed)*
- *Rufus Road at Site Access #3* *(Proposed)*
- *Rivercross Apartments Access at Site Access #4* *(Proposed)*

Below is a detailed description of the existing study area roadway network. All Average Annual Daily Traffic (AADT) information provided in this description was obtained from the North Carolina Department of Transportation (NCDOT) via the www.ncdot.gov website.

NC 16 Bypass is a four-lane divided roadway facility that travels north/south in the vicinity of the proposed development. NCDOT functional classification maps show NC 16 Bypass as a principal arterial in the area of the proposed development. Land uses along NC 16 Bypass are primarily open space. The posted speed limit on this section of NC 16 Bypass is 60 miles per hour (mph). NCDOT Average Annual Daily Traffic (AADT) counts show 22,000 vehicles per day (vpd) on NC 16 Bypass in 2014 near Optimist Club Road.

NC 16 Business is a two-lane undivided roadway facility with a center two-way left-turn lane in various locations that travels north/south in the vicinity of the proposed development. NCDOT functional classification maps show NC 16 Business as a minor arterial in the area of the proposed development. Land uses along NC 16 Business are primarily low-density residential and commercial. The posted speed limit on this section of NC 16 Business is 45 mph. NCDOT AADT counts show 17,000 vpd on NC 16 Business in 2012 near Natalie Commons Drive.

Optimist Club Road (SR 1380) is a two-lane undivided roadway that connects NC 16 Bypass and Triangle Circle. The land use along Optimist Road is primarily residential. NCDOT functional classification maps show Optimist Club Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph.

Triangle Circle (SR 1388) is a two-lane undivided roadway loop road that connects to NC 16 Business on both ends. The land use along Triangle Circle is primarily residential. NCDOT functional classification maps show Triangle Circle as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph. NCDOT AADT counts show 4,000 vpd on Triangle Circle in 2012 near the north intersection with NC 16 Business. Near the south intersection with NC 16 Business, the AADT counts show 1,800 vpd in 2013.

Unity Church Road (SR 1439) is a two-lane undivided roadway that travels east-west from a peninsula on Lake Norman to the signalized intersection with NC 16 Business and Triangle Circle. The land use along Unity Church Road is primarily low-density residential. NCDOT functional classification maps show Unity Church Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph. NCDOT AADT counts show 5,700 vpd on Triangle Circle in 2013 near the intersection with NC 16 Business.

Airlie Parkway is a two-lane undivided roadway with a center two-way left-turn lane in various locations that connects Optimist Club Road and Rufus Road. The land use along Airlie Parkway is residential and commercial/industrial. NCDOT functional classification maps show Optimist Club Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph.

Rufus Road (SR 1387) is a two-lane undivided roadway that connects Airlie Parkway and Optimist Club Road. The land use along Rufus Road is primarily low-density residential. NCDOT functional classification maps show Rufus Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph.

The purpose of this Traffic Impact Analysis Report is to assess the traffic carrying capacity of surrounding roadway network. There are a total of four (4) types of analyses for the intersections affected by the proposed development. The "Existing Conditions" analysis uses the traffic counts available to evaluate the current intersection operational performance. Traffic counts were taken in September 2016 at the study intersections. The "No-Build" analysis examines the future traffic conditions where the proposed development is not constructed. A minimum growth factor of two percent (2%) per year is proposed to be used to determine future traffic volumes. The "Build" analysis comprises the full build-out of the site with the outlying future traffic, and evaluates the intersection operational performance. The last analysis, "Build Improved" highlights the mitigation needed if the "Build" analysis shows deficiencies in the study area. This analysis will report improvements and their effect on the studied intersections. All of the analyses are performed for the AM and PM peak hours. That is, the highest volume hour between 7:00 and 9:00 AM for the AM peak hour. The PM peak hour is then the highest volume hour between 4:00 and 6:00 PM.

Site Trip Generation and Distribution

The proposed development will be a residential development consisting of 180 single family homes. Trip generation equations are provided in the ITE Trip Generation Manual, 9th Edition. The development is proposed to consist of 180 single family homes (ITE Code 210). It was estimated that a total of 135 trips (34 in, 101 out) will be generated from the proposed site in the AM peak hour and 180 trips (113 in, 67 out) will be generated in the PM peak hour.

The site generated trips to and from the proposed site were distributed in accordance with the apparent traffic patterns by the users of the proposed development and the existing traffic patterns and land uses in the vicinity The resultant trip distribution for the proposed development is as follows:

- *60% to/from the south on NC 16 Bypass*
- *15% to/from the north on NC 16 Bypass*
- *20% to/from the south on NC 16 Business*
- *5% to/from the north on NC 16 Business*

2016 Existing Conditions

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

The northbound and southbound left-turn movements at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. In the PM peak hour, the westbound approach and southbound left-turn movement operate at unacceptable levels of service. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS E in the AM peak hour. This can be attributed to high southbound through movements at this location.

The eastbound approach of Optimist Club Road at Triangle Circle operates at level of service E in the PM peak hour. One of the committed improvements of the Rivercross development is to install a traffic signal as well as other geometric improvements at this intersection. As such, the level of service on this approach in the future analysis scenarios will improve to acceptable levels.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS E in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This, and the high through volumes on NC 16 Business attribute to high side street delays at this intersection.

2019 No-Build Conditions

As agreed upon in the MOU, existing traffic volumes were increased by two percent (2%) per year in addition to the approved adjacent development trips to reflect 2019 no-build traffic volumes. This analysis also includes the roadway improvements committed to by the Rivercross Apartments development discussed in the Future Roadway Conditions section.

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

The eastbound approach, northbound left-turn and the southbound left-turn movement at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. In the PM peak hour, the westbound approach and both left-turn movements at this intersection operate at unacceptable levels of service. It should be noted that the intersection's design as a restricted crossing u-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) operates at t at LOS F in the AM peak hour. This can be attributed to high southbound through movements at this location.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS F in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This, and the high through volumes on NC 16 Business attribute to high side street delays at this intersection.

The eastbound approach of Triangle Circle at NC 16 Business operates at LOS F in the AM peak hour and LOS D in the PM peak hour. This can be attributed to high thru volumes on NC 16 Business.

2019 Build Conditions

The total future build traffic volumes include both the site traffic and traffic volumes from the no-build analysis. The build analysis evaluated the traffic conditions before any improvements are implemented.

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

All approaches and left-turn movements at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. The same is true for the PM peak hour with the exception of the eastbound approach; which operates at LOS B. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS F in the AM peak hour. This can be attributed to high southbound through movements at this location.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS F in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This, and the high through volumes on NC 16 Business attribute to high side street delays at this intersection.

The eastbound approach of Triangle Circle at NC 16 Business operates at LOS F in the AM peak hour and LOS D in the PM peak hour. This can be attributed to high thru volumes on NC 16 Business.

2019 Build Improved Conditions

The results of this analysis show that with the installation of a recommended eastbound left-turn lane on Triangle Circle at NC 16 Business, that the approach level of service and delay is reduced to the approximate no-build levels.

It should be noted that the Warrant for Left and Right-Turn Lanes nomograph for at-grade unsignalized intersections contained within NCDOT's Policy on Street and Driveway Access to North Carolina Highways was reviewed against the traffic volumes at the four site access points. The only instance where turning volumes were of a level which would warrant a turn-lane is the eastbound right-turning traffic from Rufus Road into the proposed development at Site Access 3 (i.e. intersection 13). In this instance, there are 34 right-turning vehicles in the PM peak hour. While this meets the criteria in the nomograph, the through traffic in the PM peak hour is 13 vehicles. Furthermore, the number of westbound left-turns at this location is 3 vehicles in the PM peak hour. Due to the extremely low amount of conflicting traffic volumes at this proposed intersection, a right-turn lane is not recommended.

Conclusions/Recommendations

All approaches and left-turn movements at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. The same is true for the PM peak hour with the exception of the eastbound approach; which operates at LOS B. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS F in the AM peak hour. This can be attributed to high southbound through movements at this location.

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With the installation of a recommended eastbound left-turn lane on Triangle Circle at NC 16 Business, that the approach level of service and delay is reduced to the approximate no-build levels.

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Based on the findings of this study, a specific improvement has been identified and should be completed as part of the proposed development. The NCDOT *"Policy on Street and Driveway Access to North Carolina Highways"* manual was consulted to determine the appropriate storage for the recommended auxiliary lanes if warranted.

NC 16 Business at Triangle Circle (South Intersection)

- *Construct an exclusive left-turn lane with 50 feet of full-width storage and appropriate taper on eastbound Triangle Circle.*

Intersection of Airlie Parkway & Site Access 1

- *Construct Site Access 1 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

Intersection of Rufus Road & Site Access 2

- *Construct Site Access 2 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

Intersection of Rufus Road & Site Access 3

- *Construct Site Access 3 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

Intersection of Rivercross Apartments Access & Site Access 4

- *Construct Site Access 4 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

It should be noted that the Warrant for Left and Right-Turn Lanes nomograph for at-grade unsignalized intersections contained within NCDOT's Policy on Street and Driveway Access to North Carolina Highways was reviewed against the traffic volumes at the four site access points. The only instance where turning volumes were of a level which would warrant a turn-lane is the eastbound right-turning traffic from Rufus Road into the proposed development at Site Access 3 (i.e. intersection 13). In this instance, there are 34 right-turning vehicles in the PM peak hour. While this meets the criteria in the nomograph, the through traffic in the PM peak hour is 13 vehicles. Furthermore, the number of westbound left-turns at this location is 3 vehicles in the PM peak hour. Due to the extremely low amount of conflicting traffic volumes at this proposed intersection, a right-turn lane is not recommended.

INTRODUCTION

The proposed Brookdale Residential Development is located near the intersection of Rufus Road at Airlie Parkway in eastern Lincoln County, North Carolina. The development is proposed to consist of single family homes to be completed in 2019 with a total of 180 single family units.

This report summarizes the analyses of 2016 Existing conditions, 2019 No-Build conditions (without proposed development and with the Approved Adjacent Developments in place), 2019 Build conditions (with the proposed development in place), and 2019 Build Improved conditions (with proposed development and Recommended Improvements in place) during the AM and PM peak hours.

AMT (A. Morton Thomas and Associates, Inc.) was retained to determine the potential traffic impacts of this development in accordance with the traffic study guidelines set forth by Lincoln County and the North Carolina Department of Transportation (NCDOT) and the transportation improvements that may be required to accommodate these impacts. This report presents trip generation, distribution, capacity analyses, and recommendations for transportation improvements required to meet anticipated traffic demands.

Lincoln County and NCDOT were contacted to obtain background information and to establish the elements to be covered in this traffic impact analysis (TIA). Please refer to **Appendix A** for a copy of the approved Memorandum of Understanding.

STUDY AREA DESCRIPTION

As approved by Lincoln County and NCDOT, the following seven (7) intersections are included as part of the area of influence for the development (see **Figure 1**).

- *NC 16 Bypass at Optimist Club Road* *(Unsignalized RCUT intersection)*
- *Optimist Club Road at Airlie Parkway* *(Unsignalized three-legged-intersection)*
- *Optimist Club Road at Rufus Road* *(Unsignalized three-legged-intersection)*
- *Optimist Club Road at Triangle Circle* *(Unsignalized three-legged-intersection)*
- *Rufus Road at Airlie Parkway* *(Unsignalized three-legged-intersection)*
- *NC 16 Business at Triangle Circle / Unity Church Road* *(Signalized four-legged-intersection)*
- *NC 16 Business at Triangle Circle (South Intersection)* *(Unsignalized three-legged-intersection)*

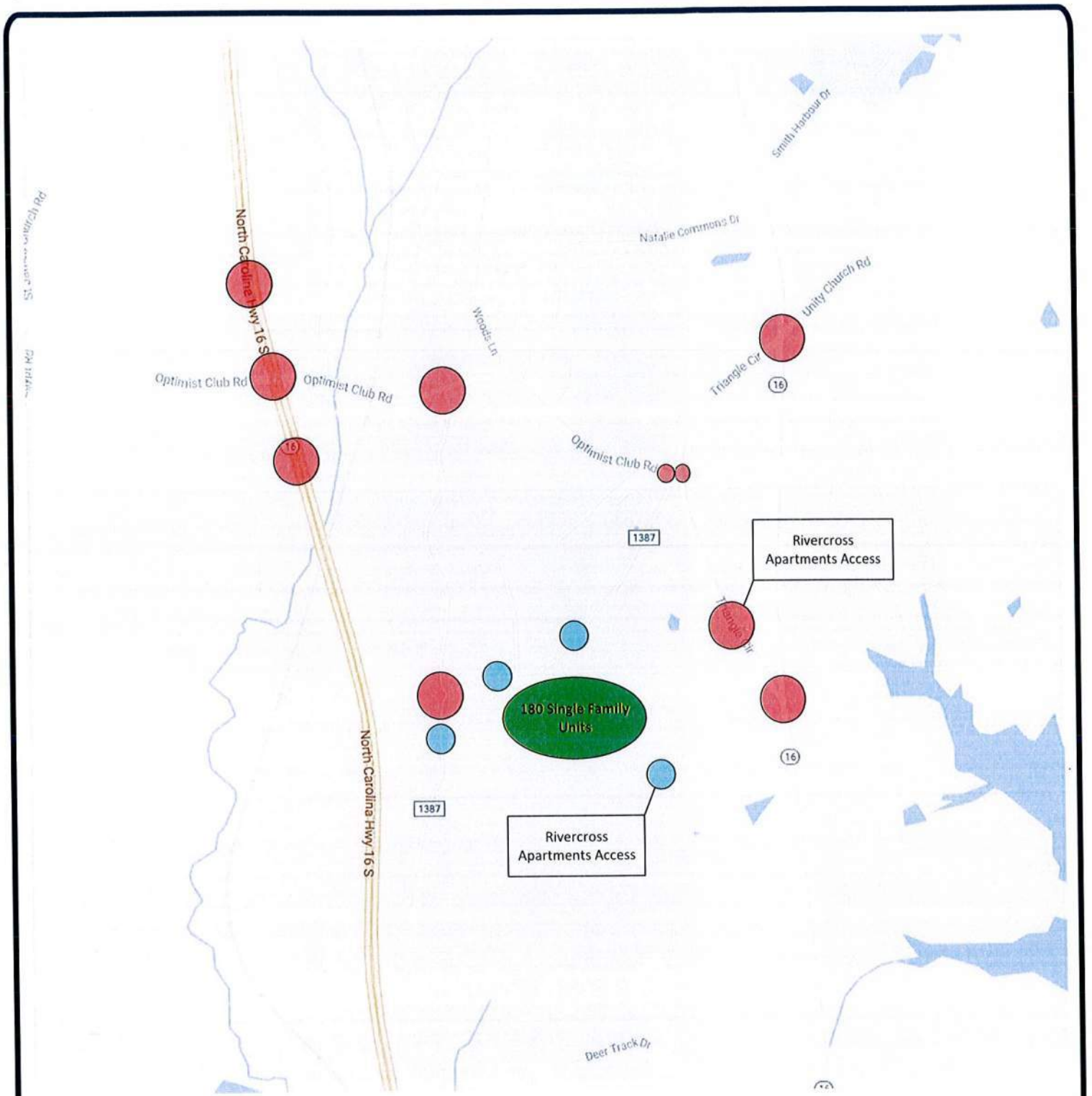
The following one (1) planned intersection are included in the study:

- *Triangle Circle at Rivercross Apartments Access* *(Unsignalized three-legged-intersection)*

The following four (4) proposed access points are included in the study:

- *Airlie Parkway at Site Access #1* *(Proposed)*
- *Rufus Road at Site Access #2* *(Proposed)*
- *Rufus Road at Site Access #3* *(Proposed)*
- *Rivercross Apartments Access at Site Access #4* *(Proposed)*

Access to the site is proposed to be provided by four (4) access points creating the four new intersections noted above. The first full-movement access point is located approximately 450 feet south of the Rufus Road and Airlie Parkway intersection. The second full-movement access point on Rufus Road is located approximately 600 feet east of the Rufus Road at Airlie Parkway intersection. The third full-movement access point on Rufus Road is located approximately 1,450 feet east of the Rufus Road and Airlie Parkway intersection. The fourth full-movement access point is planned approximately 750 feet south of the Triangle Circle and Rivercross Apartments Access intersection. All site access points will create new three-legged stop-controlled intersections. The proposed site plan is shown for illustrative purposes only in **Figure 2**.



AMT

LEGEND

- = External Intersections
- Brookdale Development
- = Site Driveways

N

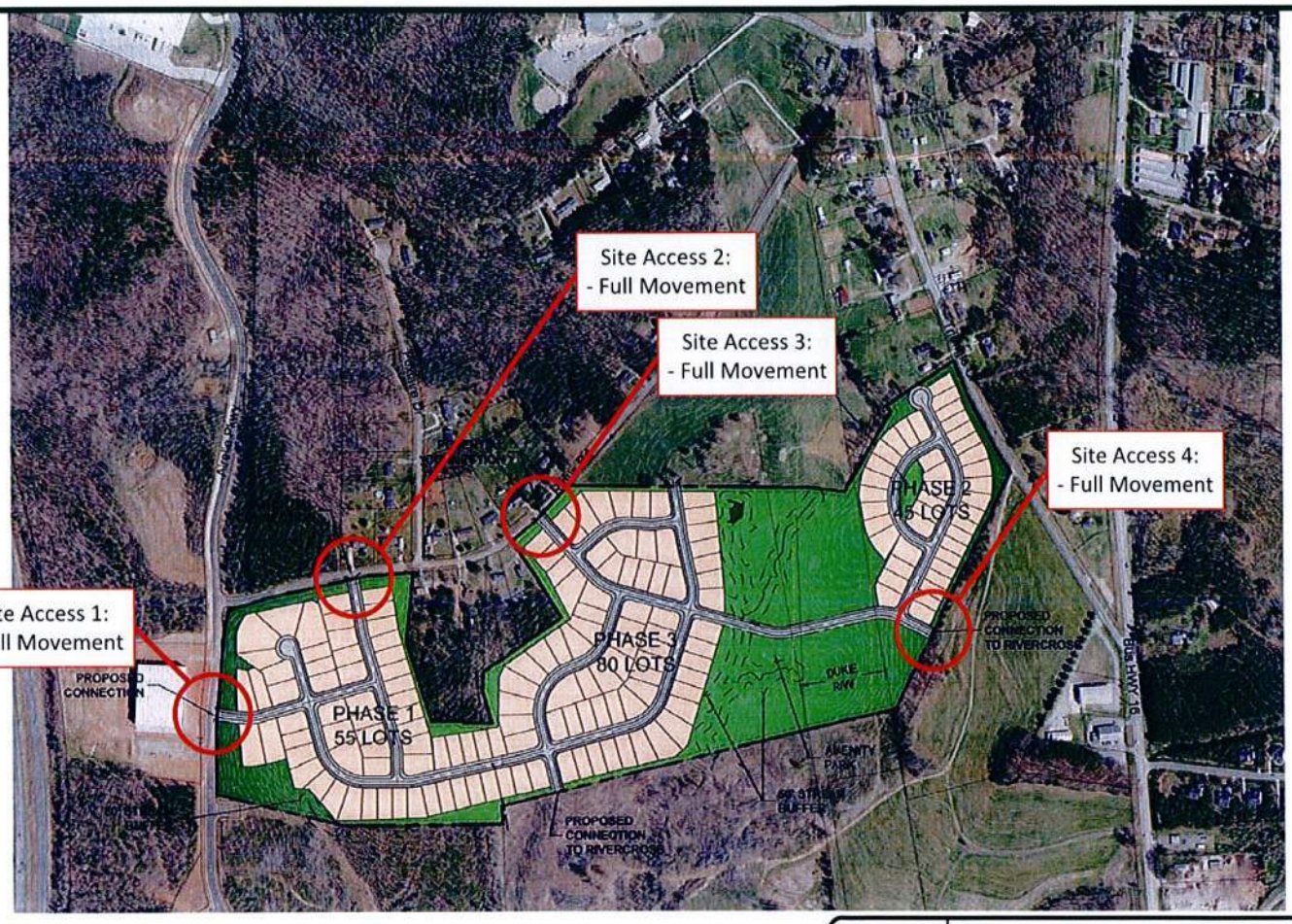
NOT TO SCALE

Brookdale Residential Development
Traffic Impact Study

Site Location Map

DATE: October 2016

FIGURE 1



N

Brookdale Residential Development
Traffic Impact Study

Site Plan

NOT TO SCALE

DATE: October 2016

FIGURE 2

AMT

EXISTING ROADWAY CONDITIONS

Below is a detailed description of the existing study area roadway network. All Average Annual Daily Traffic (AADT) information provided in this description was obtained from the North Carolina Department of Transportation (NCDOT) via the www.ncdot.gov website.

NC 16 Bypass is a four-lane divided roadway facility that travels north/south in the vicinity of the proposed development. NCDOT functional classification maps show NC 16 Bypass as a principal arterial in the area of the proposed development. Land uses along NC 16 Bypass are primarily open space. The posted speed limit on this section of NC 16 Bypass is 60 miles per hour (mph). NCDOT Average Annual Daily Traffic (AADT) counts show 22,000 vehicles per day (vpd) on NC 16 Bypass in 2014 near Optimist Club Road.

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Triangle Circle (SR 1388) is a two-lane undivided roadway loop road that connects to NC 16 Business on both ends. The land use along Triangle Circle is primarily residential. NCDOT functional classification maps show Triangle Circle as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph. NCDOT AADT counts show 4,000 vpd on Triangle Circle in 2012 near the north intersection with NC 16 Business. Near the south intersection with NC 16 Business, the AADT counts show 1,800 vpd in 2013.

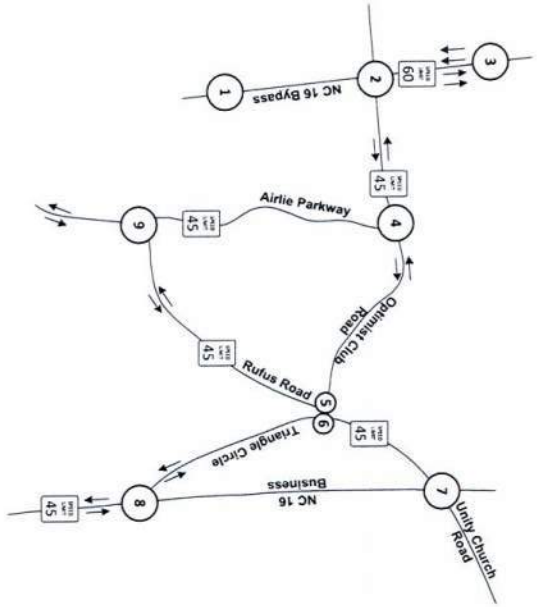
Unity Church Road (SR 1439) is a two-lane undivided roadway that travels east-west from a peninsula on Lake Norman to the signalized intersection with NC 16 Business and Triangle Circle. The land use along Unity Church Road is primarily low-density residential. NCDOT functional classification maps show Unity Church Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph. NCDOT AADT counts show 5,700 vpd on Triangle Circle in 2013 near the intersection with NC 16 Business.

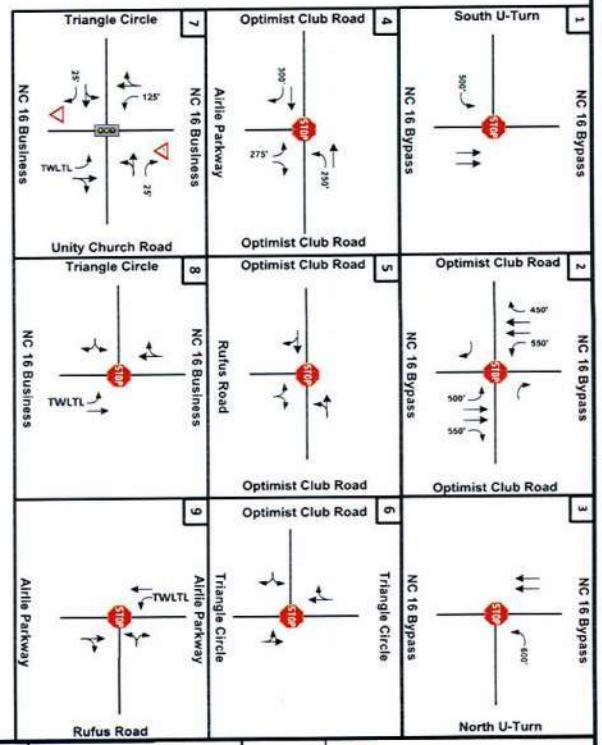
Airlie Parkway is a two-lane undivided roadway with a center two-way left-turn lane in various locations that connects Optimist Club Road and Rufus Road. The land use along Airlie Parkway is residential and commercial/industrial. NCDOT functional classification maps show Optimist Club Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph.

Rufus Road (SR 1387) is a two-lane undivided roadway that connects Airlie Parkway and Optimist Club Road. The land use along Rufus Road is primarily low-density residential. NCDOT functional classification maps show Rufus Road as a local road in the area of the proposed development. The posted speed limit on this facility is 45 mph.

All the intersections within the proposed site area are currently unsignalized except for the intersection of NC 16 Business at Triangle Circle / Unity Church Road. This signal is a four-phase fully-actuated and isolated signal maintained by NCDOT. The existing intersection geometrics are shown in Figure 3.

The purpose of this Traffic Impact Analysis Report is to assess the traffic carrying capacity of surrounding roadway network. There are a total of four (4) types of analyses for the intersections affected by the proposed development. The "Existing Conditions" analysis uses the traffic counts available to evaluate the current intersection operational performance. Traffic counts were taken in September 2016 at the study intersections. The "No-Build" analysis examines the future traffic conditions where the proposed development is not constructed. A minimum growth factor of two percent (2%) per year is proposed to be used to determine future traffic volumes. The "Build" analysis comprises the full build-out of the site with the outlying future traffic, and evaluates the intersection operational performance. The last analysis, "Build Improved" highlights the mitigation needed if the "Build" analysis shows deficiencies in the study area. This analysis will report improvements and their effect on the studied intersections. All of the analyses are performed for the AM and PM peak hours. That is, the highest volume hour between 7:00 and 9:00 AM for the AM peak hour. The PM peak hour is then the highest volume hour between 4:00 and 6:00 PM.





LEGEND

- Existing Traffic Control
- Existing Roadway
- Existing Laneage
- XXX' Storage Bay Length
- Existing Posted Speed

Brookdale Residential Development
Traffic Impact Study

Existing Lane Configurations

DATE: October 2016

NOT TO SCALE

FIGURE 3

FUTURE ROADWAY CONDITIONS

One (1) approved development is included in this analysis. Specifically, the Rivercross Apartments development. It should be noted that at this time, only the apartments land use is envisioned to be constructed by the time the Brookdale residential development is completed. As such, this report only includes the traffic and roadway improvements associated with this portion of the Rivercross development.

As noted above, the Rivercross Apartments development has committed to constructing improvements to the study area intersections. Additionally, the Brookdale residential development's fourth access point (site access #4) will connect to the Rivercross Apartments access which is envisioned to connect to Triangle Circle approximately 1,000 feet northwest of the unsignalized intersection of NC 16 Business at Triangle Circle.

The Rivercross Apartments development has committed to the following roadway improvements:

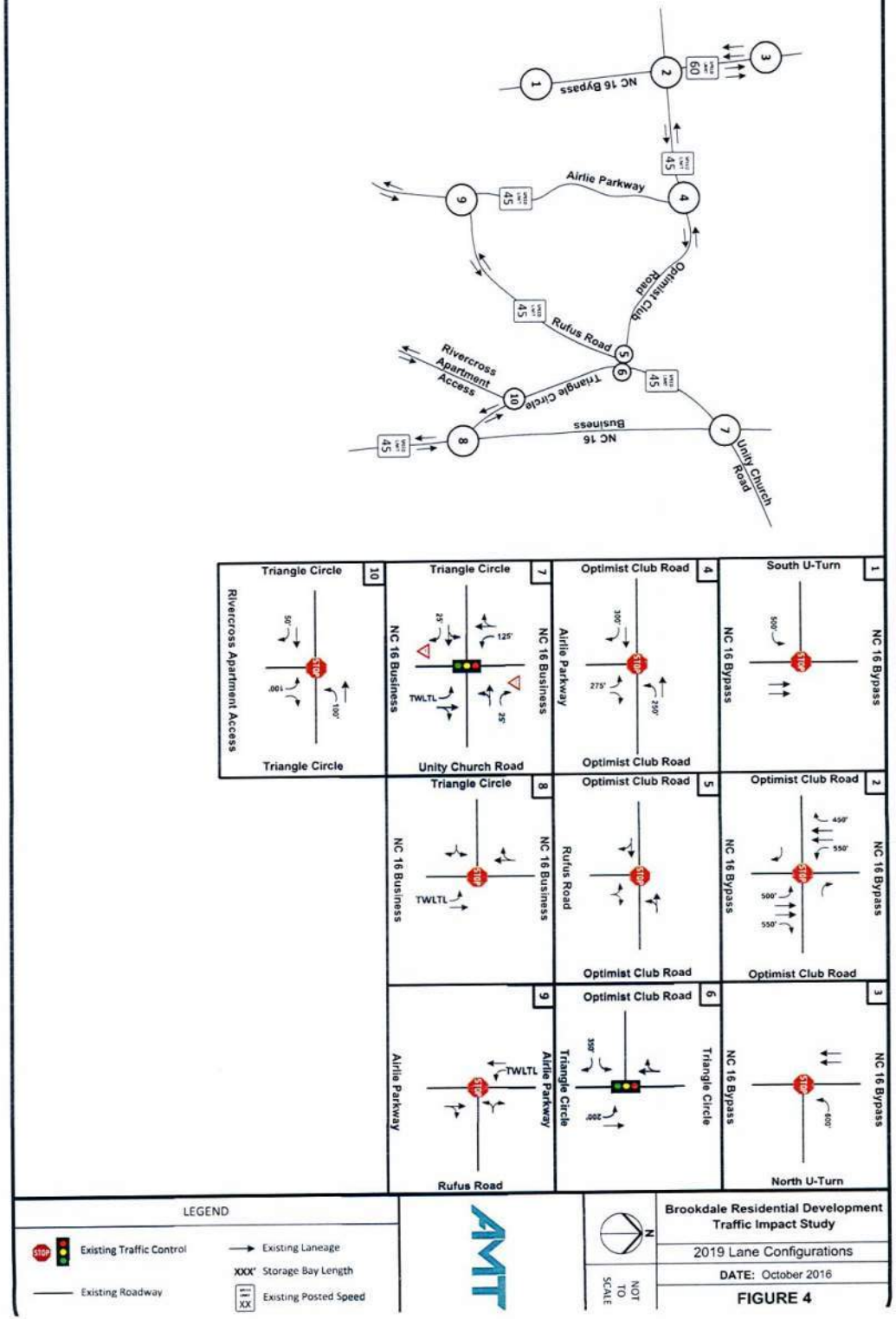
Triangle Circle at Rivercross Apartments Access

- *Construct Rivercross Apartments Access as a two-lane undivided roadway.*
- *Construct an exclusive northbound left-turn lane on Rivercross Apartments Access with 100 feet of full-width storage and appropriate taper.*
- *Construct an eastbound right-turn lane with 50 feet of full-width storage and appropriate taper on Triangle Circle.*
- *Construct a westbound left-turn lane with 100 feet of full-width storage and appropriate taper on Triangle Circle.*

Triangle Circle at Optimist Club Road

- *Install a traffic signal at the intersection to provide traffic control.*
- *Construct an exclusive northbound left-turn lane on Triangle Circle with 200 feet of full-width storage and appropriate taper.*
- *Construct an eastbound right-turn lane with 350 feet of full-width storage and appropriate taper on Optimist Club Road.*

Traffic volumes as well as the above committed improvements are incorporated into the no-build and build analysis scenarios. Figure 4 illustrates the 2019 lane configurations which is the roadway geometry and traffic control used in the no-build and build traffic scenarios. Traffic volumes associated with the Rivercross Apartments development are discussed in the project traffic volumes section. Pertinent information from the traffic study as well as the Master Planned Terms and Conditions are contained in Appendix D.


NC 16 Bypass
Airlie Parkway
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Triangle Circle
NC 16 Business
Unity Church Road
Triangle Circle
Optimist Club Road
South U-Turn
Optimist Club Road
Triangle Circle
Rivercross Apartment Access
Triangle Circle
Optimist Club Road
Rufus Road
Optimist Club Road
Optimist Club Road
Airlie Parkway
Rufus Road
Optimist Club Road
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North U-Turn
LEGEND
Existing Traffic Control
Existing Roadway
Existing Laneage
XXX' Storage Bay Length
Existing Posted Speed
NOT TO SCALE
Brookdale Residential Development
Traffic Impact Study
2019 Lane Configurations
DATE: October 2016
FIGURE 4

TRIP GENERATION

The proposed development will be a residential development consisting of 180 single family homes. Trip generation equations are provided in the ITE Trip Generation Manual, 9th Edition. The development is proposed to consist of 180 single family homes (ITE Code 210). It was estimated that a total of 135 trips (34 in, 101 out) will be generated from the proposed site in the AM peak hour and 180 trips (113 in, 67 out) will be generated in the PM peak hour.

SITE ACCESS

Access to the site is proposed to be provided by four (4) access points creating the four new intersections noted above. The first full-movement access point is located approximately 450 feet south of the Rufus Road and Airlie Parkway intersection. The second full-movement access point on Rufus Road is located approximately 600 feet east of the Rufus Road at Airlie Parkway intersection. The third full-movement access point on Rufus Road is located approximately 1,450 feet east of the Rufus Road and Airlie Parkway intersection. The fourth full-movement access point is planned approximately 750 feet south of the Triangle Circle and Rivercross Apartments Access intersection. All site access points will create new three-legged stop-controlled intersections.

TRIP DISTRIBUTION

The site generated trips to and from the proposed site were distributed in accordance with the apparent traffic patterns by the users of the proposed development and the existing traffic patterns and land uses in the vicinity The resultant trip distribution for the proposed development is as follows:

- *60% to/from the south on NC 16 Bypass*
- *15% to/from the north on NC 16 Bypass*
- *20% to/from the south on NC 16 Business*
- *5% to/from the north on NC 16 Business*

Trip distribution and trip assignment is shown in **Figure 10** and **Figure 11**; respectively.

PROJECT TRAFFIC VOLUMES

Existing Traffic Volumes

Traffic counts were performed by National Data & Surveying Services on September 7th and 28th, 2016. Traditional calendar schools in Lincoln County were confirmed to be in-session on the aforementioned dates. The traffic counts are located in Appendix B. Additionally, the balancing adjustments and traffic calculations are shown in Appendix C.

NC 16 Business at Triangle Circle / Unity Church Road is the only currently signalized intersection in the study area. For existing conditions, the phasing and timing parameters were based on the signal plans that were obtained from the NCDOT, and according to the signal plan, it is running as an isolated fully actuated signal.

Volume Balancing

Volume balancing was performed to ensure the upstream and downstream traffic volumes are balanced along the corridor. Counts between all study intersections were balanced upward with the following exception:

Traffic volumes were not balanced along Optimist Club Road between Airlie Parkway and Rufus Road. The Villages of Denver, single family home development is located between the two intersections. Not only does this development currently consist of over one-hundred single-family homes, it also provides a connection to NC 16 Business via Natalie Commons Drive. Therefore, the volumes between Airlie Parkway and Rufus Road were not balanced. The balanced count volumes represent the 2016 Existing Traffic Volumes and are shown in Figure 5.

Historical Growth Traffic (2019 Background Traffic)

Historical growth traffic is the increase in existing traffic volumes due to general usage increases and non-specific growth throughout the area. As agreed upon in the MOU, existing traffic volumes were increased by two percent (2%) per year to reflect 2019 background traffic volumes.

These 2019 Historical Growth Traffic Volumes are illustrated in Figure 6. The traffic calculations are shown in Appendix C.

Approved Development Traffic

One (1) approved development is included in this analysis. Specifically, the Rivercross Apartments development. It should be noted that at this time, only the apartments land use is envisioned to be constructed by the time the Brookdale residential development is completed. As such, this report only includes the traffic and roadway improvements associated with this portion of the Rivercross development.

The TIA estimated the 240 dwelling apartment units will generate a total of 121 trips (24 in, 97 out) will be generated from the Rivercross Apartments development in the AM peak hour and 150 trips (98 in, 52 out) will be generated in the PM peak hour.

As the development is anticipated to be partially-completed in 2019, one of the two site access points stated in the traffic study will be constructed. Therefore, the trip distribution percentages have been altered to reflect the change in access from the percentages presented in the TIA. This trip distribution is illustrated in Figure 7. The resultant approved development trip assignment is presented in Figure 8. Traffic calculations are shown in Appendix C and pertinent pages from the Rivercross TIA are located in Appendix D.

2019 No-Build Traffic Volumes

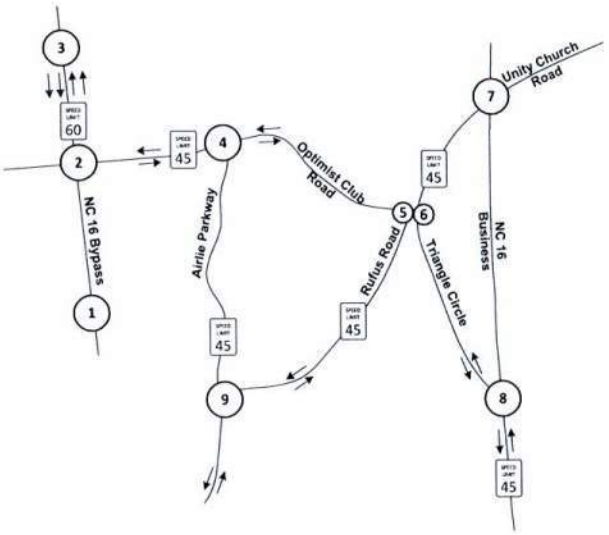
The historical growth traffic and approved development traffic volumes were then added to the existing volumes to determine the 2019 No-Build Traffic Volumes. The 2019 No-Build Traffic Volumes are shown in Figure 9.

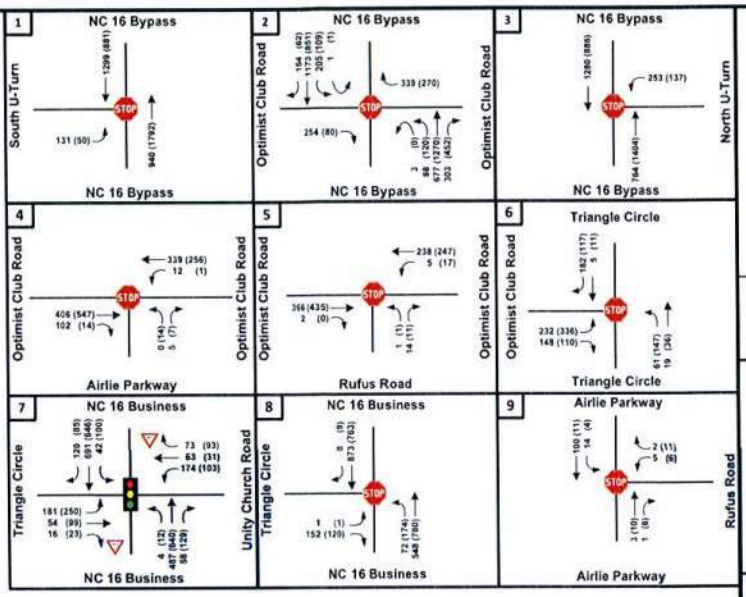
Proposed Development Traffic

The proposed development traffic was generated, distributed, and assigned to the adjacent roadway network as discussed previously. The trip distribution percentages are shown on Figure 10 and the trip assignments are shown on Figure 11. The traffic calculations are shown in Appendix C.

2019 Build-Out Traffic

The 2019 build-out traffic volumes include the 2019 no-build traffic and the proposed development traffic. The AM and PM peak-hour 2019 Build traffic volumes are shown in Figure 12. The traffic calculations are shown in Appendix C.





Brookdale Residential Development
Traffic Impact Study

2016 Existing Traffic Volumes

DATE: October 2016

FIGURE 5

N

NOT TO SCALE

AMT

LEGEND

Existing Traffic Control

XX (XX) AM (PM) Peak Hour Volumes

Existing Posted Speed

Existing Roadway

Brookdale Residential Development
Traffic Impact Study

2019 Historical Growth

DATE: October 2016

FIGURE 6

N

NOT TO SCALE

AMT

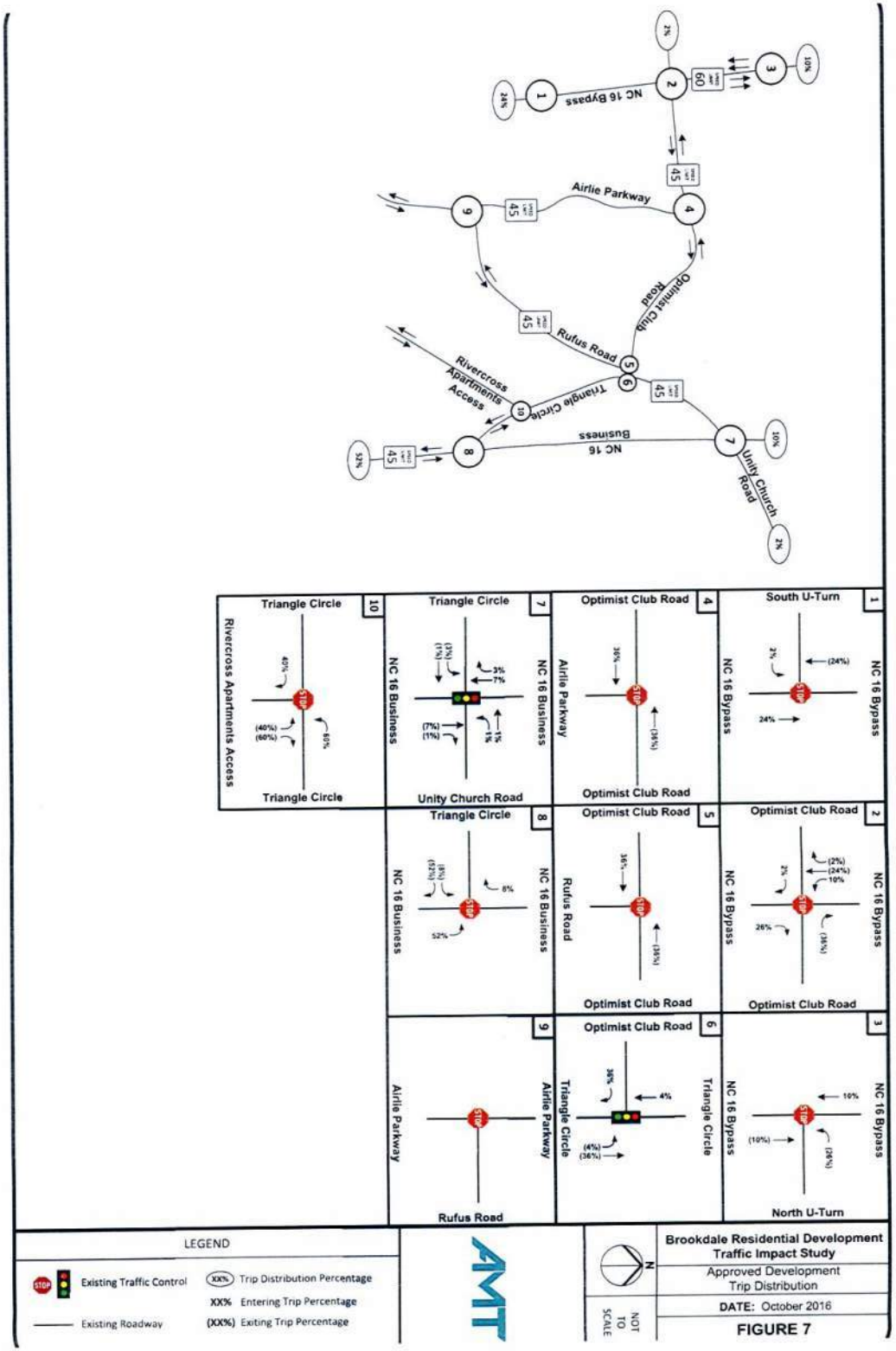
LEGEND

Existing Traffic Control

XX (XX) AM (PM) Peak Hour Volumes

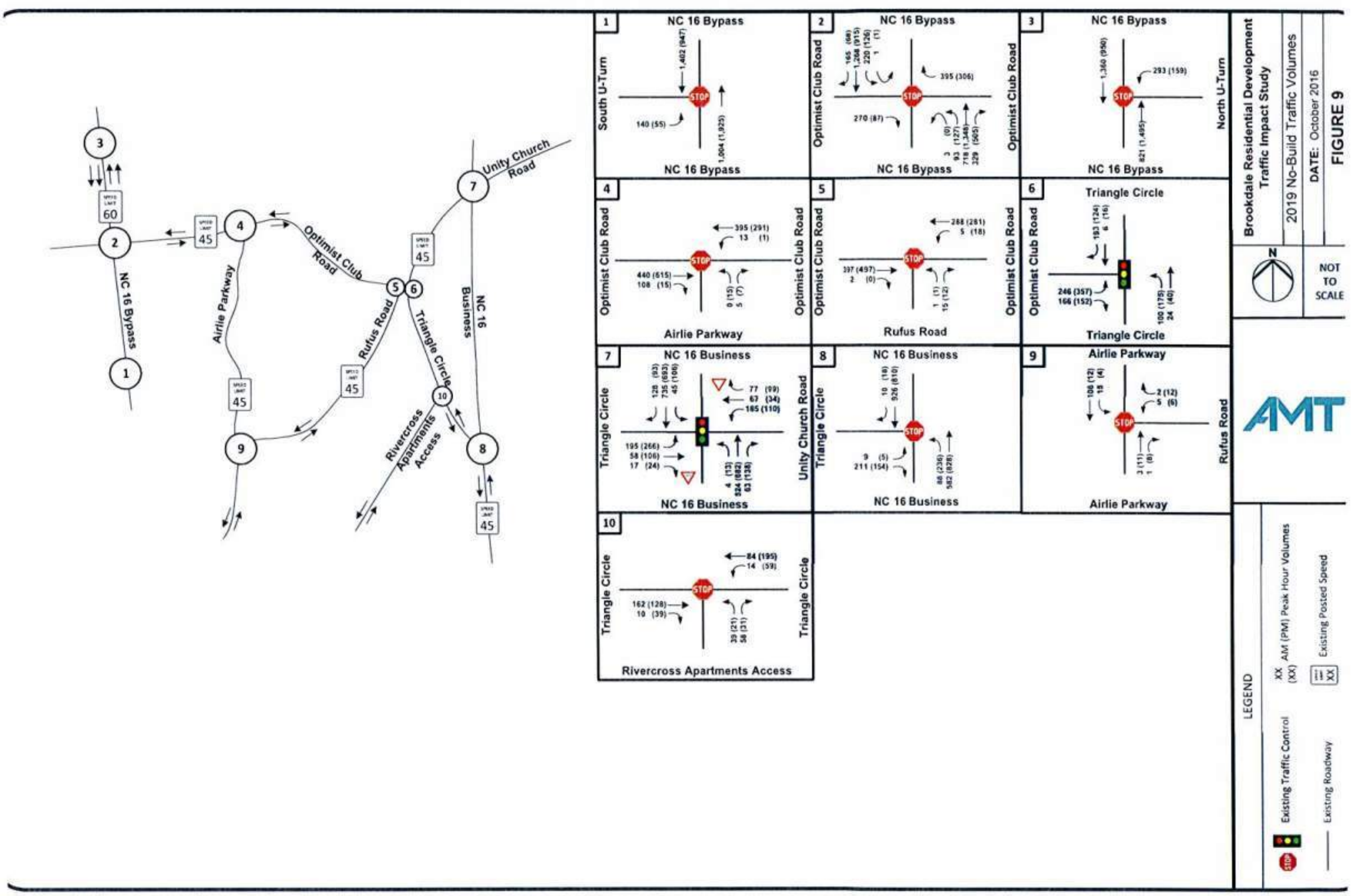
XX Existing Posted Speed

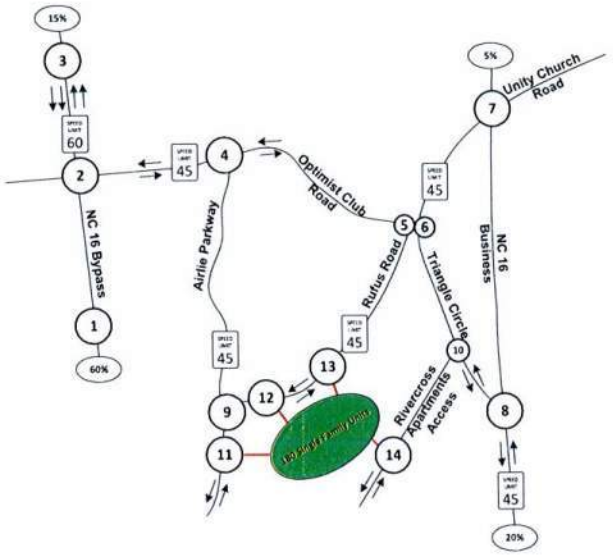
Existing Roadway

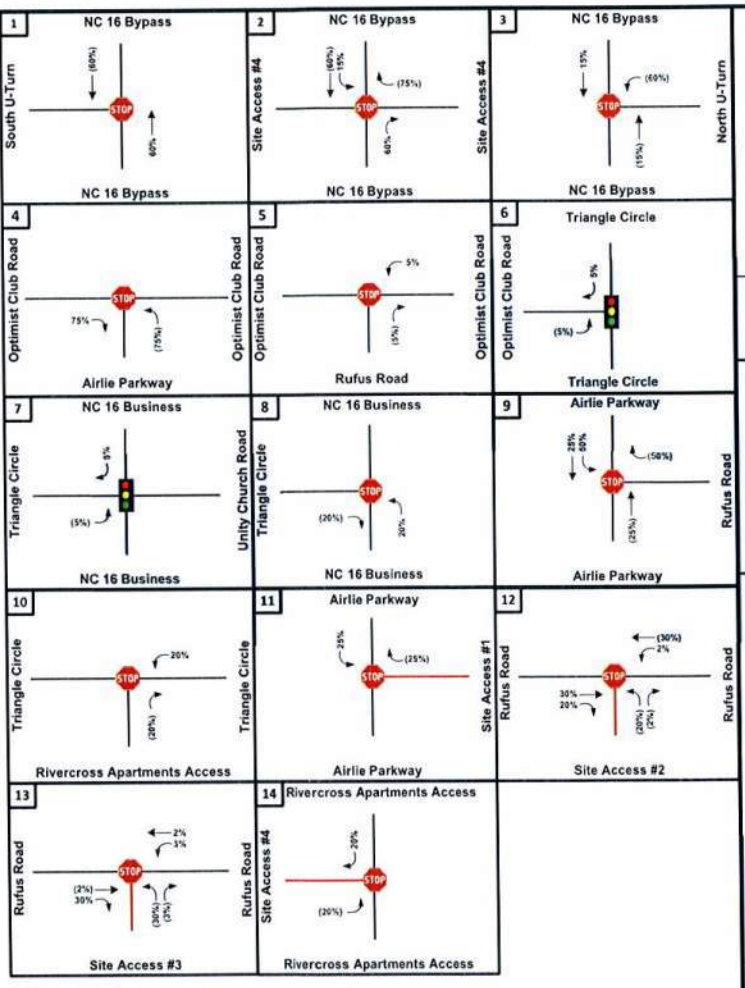

NC 16 Bypass
Airlie Parkway
Optimist Club Road
Rufus Road
Triangle Circle
Rivercross Apartments Access
NC 16 Business
Unity Church Road
South U-Turn
North U-Turn
LEGEND
Existing Traffic Control
Existing Roadway
Trip Distribution Percentage
XX% Entering Trip Percentage
(XX%) Exiting Trip Percentage
NOT TO SCALE
Brookdale Residential Development
Traffic Impact Study
Approved Development
Trip Distribution
DATE: October 2016
FIGURE 7

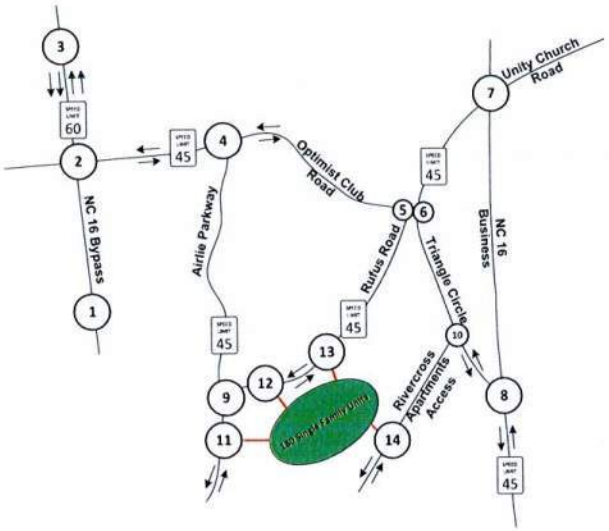
3
2
1
4
5
6
7
8
9
10
60
45
NC 16 Bypass
Airlie Parkway
Optimist Club Road
Rufus Road
Triangle Circle
Unity Church Road
NC 16 Business
Rivercross Apartments Access

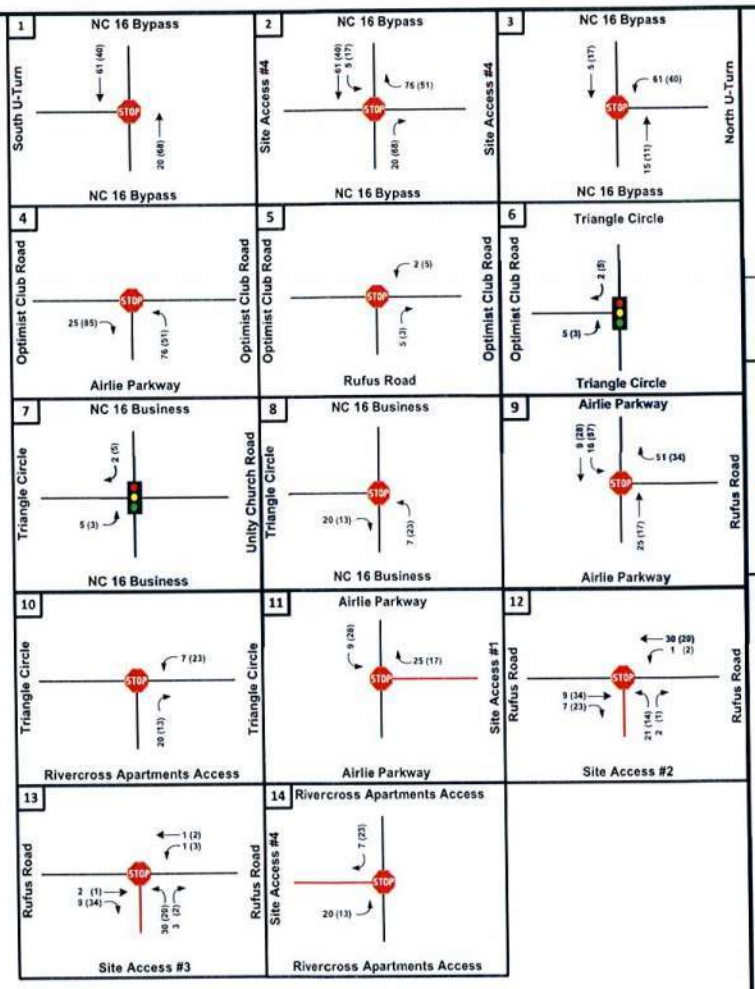
1
NC 16 Bypass
South U-Turn
NC 16 Bypass
2
NC 16 Bypass
Optimist Club Road
Optimist Club Road
NC 16 Bypass
3
NC 16 Bypass
North U-Turn
NC 16 Bypass
4
Optimist Club Road
Optimist Club Road
Airlie Parkway
5
Optimist Club Road
Optimist Club Road
Rufus Road
6
Triangle Circle
Optimist Club Road
Triangle Circle
7
NC 16 Business
Triangle Circle
Unity Church Road
NC 16 Business
8
NC 16 Business
Triangle Circle
NC 16 Business
9
Airlie Parkway
Rufus Road
Airlie Parkway
10
Triangle Circle
Triangle Circle
Rivercross Apartments Access
LEGEND
Existing Traffic Control
AM (PM) Peak Hour Volumes
Existing Posted Speed
Existing Roadway
Brookdale Residential Development
Traffic Impact Study
Approved Development
Trip Assignment
DATE: October 2016
FIGURE 8
N
NOT TO SCALE
AMT


Brookdale Residential Development
Traffic Impact Study
2019 No-Build Traffic Volumes
DATE: October 2016
FIGURE 9
NOT TO SCALE
AMT
LEGEND
Existing Traffic Control
Existing Roadway
XX (XX) AM (PM) Peak Hour Volumes
Existing Posted Speed
NC 16 Bypass
Optimist Club Road
Airlie Parkway
Rufus Road
Triangle Circle
NC 16 Business
Unity Church Road
Rivercross Apartments Access
South U-Turn
North U-Turn


15%
3
60
2
NC 16 Bypass
1
60%
45
4
Airlie Parkway
Optimist Club Road
5
6
Rufus Road
Triangle Circle
NC 16 Business
5%
Unity Church Road
7
8
9
10
11
12
13
14
Rivercross Apartments Access
20%


1
NC 16 Bypass
South U-Turn
(60%)
STOP
60%
NC 16 Bypass
2
NC 16 Bypass
Site Access #4
(60%)
15%
(75%)
STOP
60%
Site Access #4
NC 16 Bypass
3
NC 16 Bypass
15%
(60%)
STOP
(15%)
North U-Turn
NC 16 Bypass
4
Optimist Club Road
STOP
75%
(75%)
Optimist Club Road
Airlie Parkway
5
Optimist Club Road
5%
STOP
(5%)
Optimist Club Road
Rufus Road
6
Triangle Circle
Optimist Club Road
5%
(5%)
Triangle Circle
7
NC 16 Business
Triangle Circle
5%
(5%)
Unity Church Road
NC 16 Business
8
NC 16 Business
Triangle Circle
STOP
(20%)
20%
NC 16 Business
9
Airlie Parkway
25%
50%
(50%)
STOP
(25%)
Rufus Road
Airlie Parkway
10
Triangle Circle
20%
STOP
(20%)
Triangle Circle
Rivercross Apartments Access
11
Airlie Parkway
25%
STOP
(25%)
Site Access #1
Airlie Parkway
12
Rufus Road
(30%)
2%
30%
20%
STOP
(20%)
(2%)
Rufus Road
Site Access #2
13
Rufus Road
2%
3%
(2%)
30%
STOP
(30%)
(3%)
Rufus Road
Site Access #3
14
Rivercross Apartments Access
Site Access #4
29%
STOP
(20%)
Rivercross Apartments Access
LEGEND
Existing Traffic Control
Existing Roadway
(XX%) Trip Distribution Percentage
XX% Entering Trip Percentage
(XX%) Exiting Trip Percentage
Brookdale Residential Development
Traffic Impact Study
Trip Distribution
DATE: October 2016
FIGURE 10
N
NOT TO SCALE
AMT





Brookdale Residential Development
Traffic Impact Study

Trip Assignment

DATE: October 2016

FIGURE 11

N

NOT TO SCALE

AMT

LEGEND

XX (XX) AM (PM) Peak Hour Volumes

Existing Traffic Control

Existing Roadway

Existing Posted Speed

NC 16 Bypass
Airlie Parkway
Optimist Club Road
Rufus Road
Triangle Circle
NC 16 Business
Unity Church Road
Rivercross Apartments Access
Site Access #1
Site Access #2
Site Access #3
Site Access #4
South U-Turn
North U-Turn
LEGEND
Traffic Control
AM (PM) Peak Hour Volumes
Existing Roadway
Existing Posted Speed
Brookdale Residential Development
Traffic Impact Study
2019 Build Traffic Volume
DATE: October 2016
FIGURE 12
NOT TO SCALE
AMT

CAPACITY ANALYSIS

2016 Existing Analysis

The Highway Capacity Manual defines capacity as the maximum suitable flow rate at which vehicles reasonably can be expected to traverse a point during a specified time period. Capacity uses the measure of efficiency, Level-of-Service (LOS), to describe the traffic performance at intersections. LOS is defined for the overall intersection delay for signalized intersections. An acceptable LOS for a signalized intersection is considered to be LOS D or better (i.e. A, B, C or D).

At unsignalized intersections, the LOS is defined by the control delay for the movement that must yield right-of-way. It may be typical for stop-controlled minor streets to experience long delays during peak periods, while the majority of the traffic flows through the intersection on the major street experiencing little or no delay.

The procedures outlined in the Highway Capacity Manual, 2010 Update were used as guidelines for the analysis of the study area intersections. This manual provides procedures for the analysis of both signalized and unsignalized intersections. LOS categories range from LOS "A" (best) to "F" (worst) as shown in Table 1.

Table 1: Level of Service Criteria

LEVEL OF SERVICE	SIGNALIZED INTERSECTION CONTROL DELAY (SEC/VEH)	UNSIGNALIZED INTERSECTION CONTROL DELAY (SEC/VEH)	INTERSECTION LEVEL-OF-SERVICE DESCRIPTION
A	≤ 10.0	≤ 10.0	Free flow, insignificant delays.
B	10.1 – 20.0	10.1 – 15.0	Stable operation, minimal delays
C	20.1 – 35.0	15.1 – 25.0	Stable operation, acceptable delays
D	35.1 – 55.0	25.1 - 35.0	Restricted flow, common delays.
E	55.1 -80.0	35.1 – 50.0	Maximum capacity, extended delays. Volumes at or near capacity. Long queues form upstream from intersection.
F	> 80	> 50.0	Forced flow, excessive delays. Represents jammed conditions. Intersection operates below capacity with low volumes. Queues may block upstream intersections.

The LOS analysis was completed through the use of Synchro, version 9.1. The software package categorizes the LOS based on HCM methodology and criteria. According to industry standards, any signalized intersection or any approach of an unsignalized intersection is considered acceptable if the average delay is at LOS D or better with the LOS A representing little or no delay. Any signalized intersection or approach with a LOS of E or F is considered substandard and may need solutions to improve the operational performance. Signal plans were obtained from NCDOT. These plans can be found in Appendix E.

SimTraffic presents the warnings that can be attributed to the signal design of the existing intersection and the geometry of the NC 16 at Optimist Club Road RCUT intersection. Specifically, SimTraffic presents a warning that the minimum gap of phases 2 and 6 should exceed 111% of the travel time from the trailing detector. These

detectors and minimum gap settings are programmed in Synchro as shown on the signal plan. Additionally, SimTraffic presents warnings that approaches of the aforementioned RCUT intersection are less than 25 degrees. This is due to the geometry of the existing intersection. Neither of these warnings impact the capacity analysis results presented herein or SimTraffic simulations.

The traffic signal at the intersection of NC 16 Business at Triangle Circle/Unity Church Road is operating with protected/permitted left-turn phasing for the southbound left-turn movement and permitted only phasing for the northbound left-turn movement. As no geometric or signalization changes are proposed for this intersection, this phasing is kept consistent through the existing, no-build, build and build-improved analysis scenarios.

Table 2 below lists the LOS results from the Synchro capacity analysis for the 2016 Existing Traffic Conditions.

Table 2: Level of Service Analysis – 2016 Existing Traffic Conditions

LOCATION	2016 EXISTING TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 1 – NC 16 Bypass at South U-Turn (STOP-CONTROL)		
Eastbound Left-Turn	C (15.6)	C (24.4)
INTERSECTION 2 – NC 16 Bypass at Optimist Club Road (STOP-CONTROL)		
Eastbound Approach	D (30.9)	B (13.0)
Westbound Approach	C (19.3)	**E (42.6)**
Northbound Left-Turn	**F (62.1)**	D (32.6)
Southbound Left-Turn	**E (35.6)**	**F (114.6)**
INTERSECTION 3 – NC 16 Bypass at North U-Turn (STOP-CONTROL)		
Westbound Left-Turn	**E (40.4)**	C (15.1)
INTERSECTION 4 – Optimist Club Road at Airlie Parkway (STOP-CONTROL)		
Northbound Approach	B (11.0)	C (17.3)
Westbound Left-Turn	A (8.6)	A (8.7)
INTERSECTION 5 – Optimist Club Road at Rufus Road (STOP-CONTROL)		
Northbound Approach	B (11.0)	B (11.7)
Westbound Left-Turn	A (8.1)	A (8.4)
INTERSECTION 6 – Optimist Club Road at Triangle Circle (STOP-CONTROL)		
Eastbound Approach	C (15.8)	**E (38.7)**
Northbound Left-Turn	A (7.8)	A (7.8)

Table 2 (continued): Level of Service Analysis – 2016 Existing Traffic Conditions

LOCATION	2016 EXISTING TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 7 – NC 16 Business at Triangle Circle / Unity Church Road (SIGNALIZED)		
OVERALL	D (48.0)	E (55.7)
Eastbound	E (74.9)	F (83.2)
Westbound	E (60.5)	E (58.1)
Northbound	C (34.4)	E (64.2)
Southbound	D (44.3)	C (34.7)
INTERSECTION 8 – NC 16 Business at Triangle Circle (STOP-CONTROL)		
Eastbound Approach	D (30.7)	C (21.3)
Northbound Left-Turn	B (10.8)	B (11.1)
INTERSECTION 9 – Rufus Road at Airlie Parkway (STOP-CONTROL)		
Eastbound Approach	A (9.2)	A (8.7)
Northbound Left-Turn	A (7.2)	A (7.3)

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

The northbound and southbound left-turn movements at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. In the PM peak hour, the westbound approach and southbound left-turn movement operate at unacceptable levels of service. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS E in the AM peak hour. This can be attributed to high southbound through movements at this location.

The eastbound approach of Optimist Club Road at Triangle Circle operates at level of service E in the PM peak hour. One of the committed improvements of the Rivercross development is to install a traffic signal as well as other geometric improvements at this intersection. As such, the level of service on this approach in the future analysis scenarios will improve to acceptable levels.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS E in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This,

and the high through volumes on NC 16 Business attribute to high side street delays at this intersection. Synchro output pages can be found in Appendix F.

2019 No-Build Analysis

The site is proposed to be completed by year 2019. As agreed upon in the MOU, existing traffic volumes were increased by two percent (2%) per year in addition to the approved adjacent development trips to reflect 2019 no-build traffic volumes. This analysis also includes the roadway improvements committed to by the Rivercross Apartments development discussed in the Future Roadway Conditions section. The intersection and individual approach LOS results from the 2019 No-Build Analysis are displayed in Table 3. Synchro output pages can be found in Appendix F.

Table 3: Level of Service Analysis – 2019 No-Build Traffic Conditions

LOCATION	2019 NO-BUILD TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 1 – NC 16 Bypass at South U-Turn (STOP-CONTROL)		
Eastbound Left-Turn	C (16.8)	D (28.1)
INTERSECTION 2 – NC 16 Bypass at Optimist Club Road (STOP-CONTROL)		
Eastbound Approach	**E (42.3)**	B (13.7)
Westbound Approach	D (25.5)	**F (73.2)**
Northbound Left-Turn	**F (95.9)**	E (40.6)
Southbound Left-Turn	**E (46.1)**	**F (237.9)**
INTERSECTION 3 – NC 16 Bypass at North U-Turn (STOP-CONTROL)		
Westbound Left-Turn	**F (71.2)**	C (16.8)
INTERSECTION 4 – Optimist Club Road at Airlie Parkway (STOP-CONTROL)		
Northbound Approach	B (11.3)	C (17.4)
Westbound Left-Turn	A (8.4)	A (9.0)
INTERSECTION 5 – Optimist Club Road at Rufus Road (STOP-CONTROL)		
Northbound Approach	B (10.1)	B (10.7)
Westbound Left-Turn	A (8.2)	A (8.6)
INTERSECTION 6 – Optimist Club Road at Triangle Circle (SIGNALIZED)		
OVERALL	C (22.8)	C (25.4)
Eastbound Approach	C (22.8)	C (24.1)
Northbound Approach	C (22.8)	C (27.3)
Southbound Approach	C (23.0)	C (26.9)

Table 3 (continued): Level of Service Analysis – 2019 No-Build Traffic Conditions

LOCATION	2019 NO-BUILD TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 7 – NC 16 Business at Triangle Circle / Unity Church Road (SIGNALIZED)		
OVERALL	D (54.3)	E (66.8)
Eastbound	F (89.2)	F (94.2)
Westbound	E (70.5)	E (62.9)
Northbound	D (35.8)	F (83.8)
Southbound	D (50.0)	D (39.8)
INTERSECTION 8 – NC 16 Business at Triangle Circle (STOP-CONTROL)		
Eastbound Approach	F (68.1)	D (33.0)
Northbound Left-Turn	B (11.3)	B (12.5)
INTERSECTION 9 – Rufus Road at Airlie Parkway (STOP-CONTROL)		
Eastbound Approach	A (9.3)	A (8.7)
Northbound Left-Turn	A (7.2)	A (7.3)
INTERSECTION 10 – Triangle Circle at Rivercross Apartments Access (STOP-CONTROL)		
Northbound Approach	B (10.0)	B (10.4)
Westbound Left-Turn	A (7.6)	A (7.6)

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

The eastbound approach, northbound left-turn and the southbound left-turn movement at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. In the PM peak hour, the westbound approach and both left-turn movements at this intersection operate at unacceptable levels of service. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS F in the AM peak hour. This can be attributed to high southbound through movements at this location.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS F in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This, and the high through volumes on NC 16 Business attribute to high side street delays at this intersection.

The eastbound approach of Triangle Circle at NC 16 Business operates at LOS F in the AM peak hour and LOS D in the PM peak hour. This can be attributed to high thru volumes on NC 16 Business. Synchro output pages can be found in Appendix F.

2019 Build Analysis

The total future build traffic volumes include both the site traffic and traffic volumes from the No-Build Analysis. The Build Analysis evaluates the traffic conditions before any improvements are implemented. Table 4 shows the LOS results for the intersections within the study area. Synchro output pages can be found in Appendix F.

Table 4: Level of Service Analysis – 2019 Build Traffic Conditions

LOCATION	2019 BUILD TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 1 – NC 16 Bypass at South U-Turn (STOP-CONTROL)		
Eastbound Left-Turn	C (17.1)	D (30.0)
INTERSECTION 2 – NC 16 Bypass at Optimist Club Road (STOP-CONTROL)		
Eastbound Approach	E (49.3)	B (14.1)
Westbound Approach	E (38.4)	F (118.9)
Northbound Left-Turn	F (122.4)	E (45.8)
Southbound Left-Turn	F (50.8)	F (255.4)
INTERSECTION 3 – NC 16 Bypass at North U-Turn (STOP-CONTROL)		
Westbound Left-Turn	F (129.2)	C (19.1)
INTERSECTION 4 – Optimist Club Road at Airlie Parkway (STOP-CONTROL)		
Northbound Approach	C (22.4)	C (22.6)
Westbound Left-Turn	A (8.4)	A (9.0)
INTERSECTION 5 – Optimist Club Road at Rufus Road (STOP-CONTROL)		
Northbound Approach	B (10.0)	B (10.6)
Westbound Left-Turn	A (8.3)	A (8.6)
INTERSECTION 6 – Optimist Club Road at Triangle Circle (SIGNALIZED)		
OVERALL	C (23.0)	C (25.6)
Eastbound Approach	C (22.9)	C (24.3)
Northbound Approach	C (23.0)	C (27.6)
Southbound Approach	C (23.3)	C (27.1)

Table 4 (continued): Level of Service Analysis – 2019 Build Traffic Conditions

LOCATION	2019 BUILD TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 7 – NC 16 Business at Triangle Circle / Unity Church Road (SIGNALIZED)		
OVERALL	D (55.0)	E (76.5)
Eastbound	F (90.6)	F (206.9)
Westbound	E (71.0)	D (43.5)
Northbound	D (35.9)	E (68.3)
Southbound	D (50.8)	C (35.0)
INTERSECTION 8 – NC 16 Business at Triangle Circle (STOP-CONTROL)		
Eastbound Approach	F (85.1)	D (33.6)
Northbound Left-Turn	B (11.4)	B (12.9)
INTERSECTION 9 – Rufus Road at Airlie Parkway (STOP-CONTROL)		
Eastbound Approach	A (8.8)	A (8.9)
Northbound Left-Turn	A (7.3)	A (7.4)
INTERSECTION 10 – Triangle Circle at Rivercross Apartments Access (STOP-CONTROL)		
Northbound Approach	B (10.0)	B (10.5)
Westbound Left-Turn	A (7.6)	A (7.7)
INTERSECTION 11 – Airlie Parkway at Site Access #1 (PROPOSED STOP-CONTROL)		
Westbound Approach	A (8.4)	A (8.5)
Southbound Left-Turn	A (7.2)	A (7.3)
INTERSECTION 12 – Rufus Road at Site Access #2 (PROPOSED STOP-CONTROL)		
Northbound Approach	A (9.0)	A (9.1)
Westbound Left-Turn	A (7.3)	A (7.4)
INTERSECTION 13 – Rufus Road at Site Access #3 (PROPOSED STOP-CONTROL)		
Northbound Approach	A (8.8)	A (8.9)
Westbound Left-Turn	A (7.3)	A (7.3)
INTERSECTION 14 – Rivercross Apartments Access at Site Access #4 (PROPOSED STOP-CONTROL)		
Eastbound Approach	A (9.0)	A (9.1)
Northbound Left-Turn	A (0.0)	A (0.0)

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

All approaches and left-turn movements at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. The same is true for the PM peak hour with the exception of

the eastbound approach; which operates at LOS B. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS F in the AM peak hour. This can be attributed to high southbound through movements at this location.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS F in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This, and the high through volumes on NC 16 Business attribute to high side street delays at this intersection.

The eastbound approach of Triangle Circle at NC 16 Business operates at LOS F in the AM peak hour and LOS D in the PM peak hour. This can be attributed to high thru volumes on NC 16 Business. Synchro output pages can be found in Appendix F.

2019 Build Improved Analysis

Table 5 shows the analysis results within the study area with the recommended improvements. The full-list of recommended improvements are listed in the Recommendations section. Synchro output pages can be found in Appendix F.

Table 5: Level of Service Analysis – 2019 Build Improved Traffic Conditions

LOCATION	2019 BUILD IMPROVED TRAFFIC CONDITIONS	
	AM PEAK LOS (delay/veh)	PM PEAK LOS (delay/veh)
INTERSECTION 8 – NC 16 Business at Triangle Circle (STOP-CONTROL)		
Eastbound Approach	F (70.8)	D (29.1)
Northbound Left-Turn	B (11.4)	B (12.9)

The results of this analysis show that with the installation of a recommended eastbound left-turn lane on Triangle Circle at NC 16 Business, that the approach level of service and delay is reduced to the approximate no-build levels.

It should be noted that the Warrant for Left and Right-Turn Lanes nomograph for at-grade unsignalized intersections contained within NCDOT's Policy on Street and Driveway Access to North Carolina Highways was reviewed against the traffic volumes at the four site access points. The only instance where turning volumes were of a level which would warrant a turn-lane is the eastbound right-turning traffic from Rufus Road into the proposed development at Site Access 3 (i.e. intersection 13). In this instance, there are 34 right-turning vehicles in the PM peak hour. While this meets the criteria in the nomograph, the through traffic in the PM peak hour is 13 vehicles. Furthermore, the number of westbound left-turns at this location is 3 vehicles in the PM peak hour. Due to the extremely low amount of conflicting traffic volumes at this proposed intersection, a right-turn lane is not recommended.

CONCLUSIONS

The proposed Brookdale Residential Development is located near the intersection of Rufus Road at Airlie Parkway in eastern Lincoln County, North Carolina. The development is proposed to consist of single family homes to be completed in 2019 with a total of 180 single family units. It is estimated that the proposed development will generate a total of 135 trips (34 in, 101 out) in the AM peak hour and 180 trips (113 in, 67 out) will be generated in the PM peak hour.

The results of this analysis indicate that all study area intersections, approaches, and movements operate with acceptable levels of service in the AM and PM peak hours with a few notable exceptions.

All approaches and left-turn movements at the intersection of NC 16 Bypass at Optimist Club Road operate at unacceptable levels of service the in AM peak hour. The same is true for the PM peak hour with the exception of the eastbound approach; which operates at LOS B. It should be noted that the intersection's design as a restricted crossing U-turn (RCUT) intersection greatly favors the northbound and southbound through movements at this unsignalized intersection. As such, lower-volume eastbound and westbound right-turns and the northbound and southbound left-turns operate with longer delays at this type of intersection. Therefore, the northern U-turn (i.e. westbound approach) at the RCUT intersection operates at LOS F in the AM peak hour. This can be attributed to high southbound through movements at this location.

The signalized intersection of NC 16 Business at Triangle Circle / Unity Church Road operates with higher delays on the side street approaches in both the AM and PM peak hours. Additionally, the northbound approach operates at LOS F in the PM peak hour. This results in the overall intersection operating at LOS D in the AM peak hour and LOS E in the PM peak hour. This intersection currently operates with split side street phasing meaning that the Triangle Circle approach runs separately than the Unity Church Road approach instead of operating concurrently. This is a less efficient means of signal timing, however, it may be for safety purposes. In this instance, it is possible that the highly directional traffic volumes and intersection geometry led to the signal design to utilize spilt phasing. This, and the high through volumes on NC 16 Business attribute to high side street delays at this intersection.

With the installation of a recommended eastbound left-turn lane on Triangle Circle at NC 16 Business, that the approach level of service and delay is reduced to the approximate no-build levels.

It should be noted that the Warrant for Left and Right-Turn Lanes nomograph for at-grade unsignalized intersections contained within NCDOT's Policy on Street and Driveway Access to North Carolina Highways was reviewed against the traffic volumes at the four site access points. The only instance where turning volumes were of a level which would warrant a turn-lane is the eastbound right-turning traffic from Rufus Road into the proposed development at Site Access 3 (i.e. intersection 13). In this instance, there are 34 right-turning vehicles in the PM peak hour. While this meets the criteria in the nomograph, the through traffic in the PM peak hour is 13 vehicles. Furthermore, the number of westbound left-turns at this location is 3 vehicles in the PM peak hour. Due to the extremely low amount of conflicting traffic volumes at this proposed intersection, a right-turn lane is not recommended.

The above recommended improvement and recommended laneage and traffic control for the proposed access points are listed in the Recommendations section.

RECOMMENDATIONS

Based on the findings of this study, a specific improvement has been identified and should be completed as part of the proposed development. The NCDOT *"Policy on Street and Driveway Access to North Carolina Highways"* manual was consulted to determine the appropriate storage for the recommended auxiliary lanes if warranted.

NC 16 Business at Triangle Circle (South Intersection)

- *Construct an exclusive left-turn lane with 50 feet of full-width storage and appropriate taper on eastbound Triangle Circle.*

Intersection of Airlie Parkway & Site Access 1

- *Construct Site Access 1 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

Intersection of Rufus Road & Site Access 2

- *Construct Site Access 2 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

Intersection of Rufus Road & Site Access 3

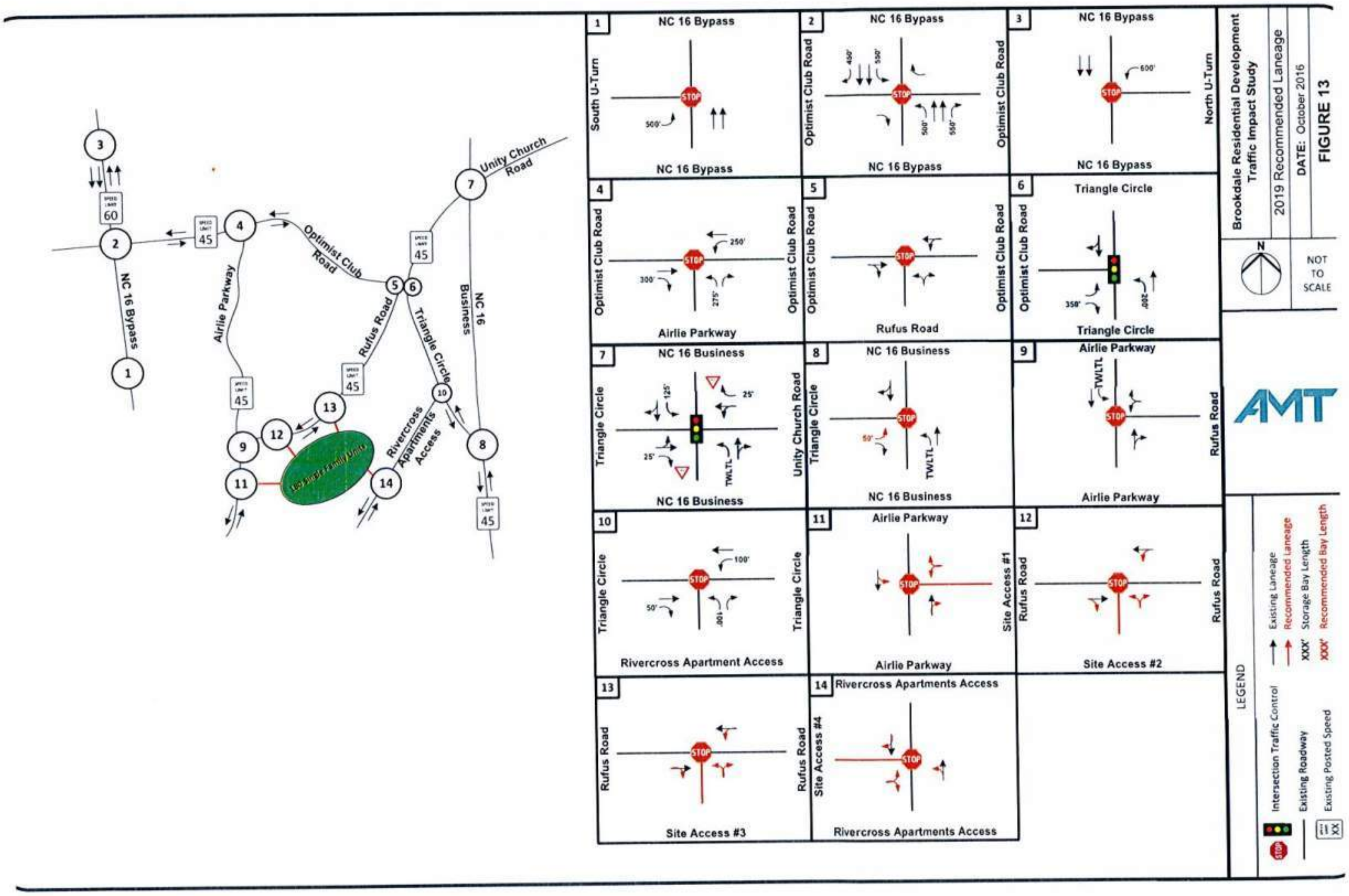
- *Construct Site Access 3 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

Intersection of Rivercross Apartments Access & Site Access 4

- *Construct Site Access 4 with one (1) ingress lane and one (1) egress lanes consisting of a shared left and right-turn lane. The proposed intersection will operate under stop-control.*

It should be noted that the Warrant for Left and Right-Turn Lanes nomograph for at-grade unsignalized intersections contained within NCDOT's Policy on Street and Driveway Access to North Carolina Highways was reviewed against the traffic volumes at the four site access points. The only instance where turning volumes were of a level which would warrant a turn-lane is the eastbound right-turning traffic from Rufus Road into the proposed development at Site Access 3 (i.e. intersection 13). In this instance, there are 34 right-turning vehicles in the PM peak hour. While this meets the criteria in the nomograph, the through traffic in the PM peak hour is 13 vehicles. Furthermore, the number of westbound left-turns at this location is 3 vehicles in the PM peak hour. Due to the extremely low amount of conflicting traffic volumes at this proposed intersection, a right-turn lane is not recommended.

The Recommended Improvements are shown in Figure 13.


Brookdale Residential Development
Traffic Impact Study
2019 Recommended Laneage
DATE: October 2016
FIGURE 13
NOT TO SCALE
AMT
LEGEND
Intersection Traffic Control
Existing Roadway
Existing Posted Speed
Existing Laneage
Recommended Laneage
XXX' Storage Bay Length
XXX' Recommended Bay Length
NC 16 Bypass
Airlie Parkway
Optimist Club Road
Rufus Road
Triangle Circle
NC 16 Business
Unity Church Road
Rivercross Apartments Access
60
45
1 NC 16 Bypass South U-Turn 500'
2 NC 16 Bypass Optimist Club Road 450' 550' 500' 550'
3 NC 16 Bypass North U-Turn 600'
4 Optimist Club Road Airlie Parkway 250' 300' 275'
5 Optimist Club Road Rufus Road
6 Triangle Circle Optimist Club Road 350' 200'
7 NC 16 Business Triangle Circle Unity Church Road 125' 25' 25' TWLTL
8 NC 16 Business Triangle Circle 50' TWLTL
9 Airlie Parkway Rufus Road TWLTL
10 Triangle Circle Rivercross Apartment Access 100' 50' 100'
11 Airlie Parkway Site Access #1
12 Rufus Road Site Access #2
13 Rufus Road Site Access #3
14 Rivercross Apartments Access Site Access #4